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ABSTRACT

Because of the interest in an increasing usage of formal planning, programming, budgeting systems (PPBS), this report carefully analyzes the nature and role of PPBS and its potential impact on higher education. Part I describes the salient features of PPBS and traces the development and related analytical techniques in governmental agencies and institutions of higher education. Part II illustrates both the concepts and implementation of PPBS by a detailed explication of the University of California's experience with it. Part II suggests a form of policy analysis for educational planning which is an alternative to traditional PPBS and concludes with a case study of policy analysis applied to year-round operations and with general suggestions for managers seeking to improve their resource allocation procedures. The benefits and complexities of PPBS may not be worth the costs in all situations, and educational institutions should carefully weigh these factors and realize that there are no easy, automatic answers to the problems of higher education. An extensive bibliography is included. (Author)

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PPBS IN HIGHER EDUCATION
PLANNING AND MANAGEMENT

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TABLE OF CONTENTS

Page

PREFACE ii

LIST OF TABLES. iv

LIST OF FIGURES iv

PART I: AN OVERVIEW OF PPBS IN HIGHER EDUCATION PLANNING AND MANAGEMENT 1

Introduction. 2
Development of PPBS 3
What is PPBS? 4
The Federal and State Experience with PPBS in the United States . . 7
PPBS in Postsecondary Education 11
Development of Educational Planning Models. 16
Summary 18
Footnotes 20

PART II: THE UNIVERSITY OF CALIFORNIA EXPERIENCE WITH PPBS 21

Introduction. 22
PPBS and the Multi-Campus Structure of the University 32
The New Situation: Revised Targets for the Future, and Program Review 33
Footnotes 49

PART III: PERSPECTIVES AND APPLICATIONS OF POLICY ANALYSIS 50

Introduction. 51
Analytical Base for Policy Analysis 57
Institutional Information Systems 57
General Explanatory Research. 58
Planning Tools and Techniques 60
Foci and Nature of Policy Analysis. 69
A Case Study of Year-Round Operations 73
Background. 73
Analysis of YRO 75
Conclusion. 94
Footnotes 95

BIBLIOGRAPHY. 96

PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

Higher education in the United States and elsewhere is beset by crises: crises of public confidence, questions of continuing relevance, doubts about continuing the emphasis on doctoral instruction, and a very real financial crisis. In response, governing boards and governmental agencies are devoting increasing attention to the management of higher education. Part of this response has been a heightened interest in formal planning-programming-budgeting-systems (PPBS); in fact, several states have legislated the adoption of PPBS for higher educational planning and decision making. Similar interest has been evidenced in other countries. Therefore, it is an appropriate time to reconsider the nature and role of PPBS and its potential impact on higher education.

Part I of this report describes the salient characteristics of PPBS and traces the development of PPBS and related analytical techniques in governmental agencies and institutions of higher education. Part II illustrates both the concepts and the implementation of PPBS by a detailed exposition of the University of California's experience with PPBS. Finally, Part III suggests a form of policy analysis for educational planning which

is an alternative to traditional PPBS. We conclude with a case study of policy analysis applied to year-round operations and with some general observations for educational managers seeking to improve their resource allocation procedures.

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LIST OF TABLES

Page

Table A: Functional Budget, University of California 1970-71 to 1972-73. 30

Table B: Program Budget, University of California 1970-71 to 1972-73. 31

Table 1: Comparison of Enrollments and "Capacity" of University of California General Campuses for 1970-1979 77

Table 2: Summary of Classroom Utilization Rates, Assignable Square Feet, and Variable Costs - 10-year Runs, 1969-70 - 1978-79, Using UCSB Data. 78

Table 3: Critical Class Size Values for Cost Equality Between Semester System and Quarter System Operating Under Model 1 . 85

Table 4: Table of f Factors Describing Economies of Scale for Summer Quarter Support Operations. 85

LIST OF FIGURES

Page

Figure 1: Entire System Enrollment Pattern. 83

Figure 2: Growing Campuses Enrollment Pattern 87

Figure 3: Mature Campuses Enrollment Pattern. 88

Figure 4: Plot of S-Curve Function Showing Economies of Scale in Summer Quarter Support Operations 90

Figure 5: Critical Class Size Region for Cost Equality Between Semester System and Quarter System Operating Under Models 2 and 3. 92

PART I

AN OVERVIEW OF PPBS IN HIGHER EDUCATION PLANNING AND MANAGEMENT

INTRODUCTION

The American Society is fascinated, almost hypnotized, by new things. Styles and models change rapidly over time reflecting our preoccupation with innovation if not our recognition of substantive improvement. In the same sense, planning-programming-budgeting-systems (PPBS) have been in vogue for the past decade in public sector management in the United States. Federal, state and local agencies and institutions have looked to PPBS to improve their resource allocation decisions and to structure their policy and program review processes. In particular, institutions of higher education have examined, explored, and some have nominally adopted PPBS as their basic administrative budgeting procedure. Recently, various authors have given their assessments of the contributions and inadequacies in the applications of PPBS in the Federal Government.[1]

In this section we describe the recent development of PPBS in the administration of higher education. To our knowledge, a total, comprehensive implementation of PPBS has not been achieved in any college or university in the United States. We believe that any administrator considering PPBS should be aware of the potential benefits, limitations, and costs of implementing a program budgeting system. In this spirit, we describe some of the results of a decade of attempting to implement PPBS in the Federal Government and the available experience of the higher educational community. Furthermore, it should be emphasized from the very beginning that PPBS as a tool or an approach is significantly shaped by the internal and external political realities of higher education. By its very nature, PPBS is a political instrument and the institutional and political environment

should always be borne in mind in the following discussion of the context and impact of PPBS.

Development of PPBS

Although on August 25, 1965, President Lyndon B. Johnson announced "a very new and very revolutionary system of planning and programming and budgeting throughout the vast Federal Government" (Presidential News Conference, August 25, 1965), PPBS is actually neither very new nor very revolutionary. Allen Schick (1966) has observed that PPBS is "anchored to half a century of tradition and evolution." The basic concepts of PPBS are closely related to those of performance budgeting advocated by the Hoover Commission (Commission on Organization, 1949) and even the terminology of "program budget," "program objectives," and "program costs" was used in the report of the second Hoover Commission (Commission on Organization, 1955). The performance-program budgeting concepts were expanded and further articulated by Frederick Mosher in a book entitled Program Budgeting (1954). However, the seminal work which launched the U.S. Government into PPBS was Charles Hitch and Roland McKean's The Economics of Defense in the Nuclear Age (1960).

The decade of the 1960's saw the attempted application of PPBS to all federal agencies after four years of experience in the Defense Department. A large number of thoughtful observers and special governmental studies have sought to assess the impact of PPBS in the Federal Government and their conclusions are discussed briefly in a subsequent section. In the latter part of the 1960's, several state governments, including the State of California, also formally adopted PPBS and imposed it on all state agencies, including public institutions of higher education. At

the same time, the American Council on Education and other educational associations and professional organizations initiated major efforts in the study of the applicability of PPBS to institutions of higher education. Harry Williams' pioneering work, Planning for Effective Resource Allocation in Universities (1966), distilled much of the relevant federal PPBS experience and wisdom and presented several possible PPBS formats for arraying institutional planning and budgetary data. Stimulated by the works of Williams (1966), Novick (1960), Hirsch (1965) and others, educational institutions began to develop their own analytical data bases and planning and management systems as a prelude to implementing PPBS.

In 1969, the United States Office of Education funded a major inter-institutional PPBS development program at the initiation of statewide planners and executives of several major universities, including the State University of New York, University of Illinois, the University of California, and other institutions in the thirteen Western States. In two years, this program has developed into the National Center for Higher Education Management Systems (NCHEMS)[2] and is currently the major national focus for PPBS development for higher education in the United States.

Before discussing the implementation process and administrative experience of PPBS at the various governmental levels, we turn first to the nature and substance of PPBS itself.

What is PPBS?

While the Director of the Bureau of the Budget, Charles Schultze (1967) defined the principle objective of PPBS as

> to improve the basis for major program decisions, both in the operating agencies and in the Executive Office of the President. To do this, it is necessary to have clear

> statements of what the decisions are and why they were made. Program objectives are to be identified and alternate methods of meeting those objectives are to be subjected to systematic comparison. Data are to be organized on the basis of major programs, and are to reflect future as well as current implications of decisions.

In the pure, formal construct, PPBS seeks to attain this objective by utilizing two principal instruments: a program budget and cost-benefit analysis.

A program budget is a format for organizing and presenting information about the costs and benefits of the output producing activities of an organization. Its principal objective is to facilitate planning, analysis, and resource allocation decision making by all levels of management of an organization. Its principal distinguishing characteristics are: a structuring of activities in terms of output-producing programs; the organization of these programs (or program elements) in relation to explicitly stated objectives and sub-objectives of the organization; a focus on the outputs (or benefits) as well as the costs of the programs; an emphasis on total variable costs associated with each activity (or program); a closer integration of substantive academic and financial planning; and a projection of both the costs and outputs of the programs, in accordance with some agreed plan, over a significant number of years into the future.[3]

The key conceptual components of a PPB *System* are: systematic long-range planning (5 - 15 years) which clearly articulates objectives and carefully examines the costs and benefits of alternative courses of action which meet these global objectives; a selection process for deciding on a specific course of action (1 - 5 years) in the context of the examined alternatives and chosen objectives (programming); translating these decisions into immediate (0 - 1 years), specific financial, manpower, and policy plans (budgeting); and recognizing a multi-year planning horizon

and incorporating to the fullest extent possible the total long-term costs and benefits attributable to each course of action.[4] PPBS focuses on outputs as well as inputs. PPBS seeks to relate consequences with decisions, effects with causes. PPBS attempts to quantify and evaluate the indirect (induced) costs and the external (spillover) consequences of each possible decision.

The conceptual and analytic basis for these selections, evaluations, translations and relations is cost-benefit analysis. John Keller (1969) has defined cost-benefit analysis as

> an attitude and set of formal analytic techniques which attempt to relate the costs and benefits of competing programs in a rigorous quantitative fashion so that decisions can be made about preferred courses of action.[5]

The attitudinal aspect of cost-benefit analysis in PPBS was emphasized by Bertram Gross (1969) who wrote:

> the PPB spirit is more important than the letter. Some offices practice PPB without knowing it; others go through all the formal motions without coming anywhere near it. Moreover, *there is really no one system.* [author's emphasis]

While the formal structure of PPBS differs with its organizational setting, it is illustrative to examine the four basic structural elements of a PPB System outlined by Schultze (1967) for the Federal Government:

Program Structure - grouping together the comparable activities of an agency for analysis purposes;

Program Memoranda - presenting agency objectives, alternatives considered, and major program recommendations;

Program and Financial Plan - showing for a multi-year period the current and recommended agency programs including both outputs and costs; and

Special Studies - reporting the analytical support for decisions recommended in the Program Memoranda.

Although it is unnecessary for an educational institution wishing to implement PPBS to follow this same approach, it is interesting to note that institutions have followed a similar path by developing program classification structures, program descriptions, multi-year program plans and various analytical tools and planning data bases for special studies. But this is getting us ahead of our story. Before addressing PPBS in higher education, we examine the PPBS experience of federal and state agencies with their five to ten years of additional exposure.

The Federal and State Experience with PPBS in the United States

The federal implementation of PPBS, which began in the Department of Defense in 1961 under the leadership of McNamara, Hitch and Enthoven, was extended to all federal agencies by executive order in 1965. Three years later the Bureau of the Budget examined 16 federal domestic agencies and concluded "that most agencies do not perform the planning, programming, and budgeting functions much differently than they did before the introduction of PPBS" [Botner (1970), Harper, et. al. (1969)]. As Botner described the federal experience, "While some worthwhile results have been achieved with PPBS to date, the system has failed to fulfill the expectations of its more ardent proponents." The Bureau of the Budget also engaged a management consulting firm to review the Federal PPB System and to design an integrated planning system. This study concluded in 1969 that while "the basic mechanism for planning, programming, budgeting, and execution exists," the implementation of PPBS has been fraught with problems of too little analysis submitted too late, reviewed too quickly, without a broad overview and without closely relating the PPBS, appropriation and functional budget structures (McKinsey & Company, nd.).

President Johnson chose to implement PPBS in all civilian agencies simultaneously based on the "success" of PPBS in the Department of Defense.[6] Unfortunately, the Defense Department is nonrepresentative of civilian agencies. The military services have a highly structured and authoritarian chain of command from the President to the privates. On the contrary, most civilian agencies are amalgams of disparate groups with conflicting objectives, ineffective sanctions, confused authority, and faced with the necessity of inducing the cooperation of thousands of other agencies and institutions.

The military services are able to quantify measures of effectiveness such as the volume of fire power, aircraft performance characteristics, and mobilization rates. While the military have had some difficulty adequately quantifying effectiveness [Enthoven (1969)], the task of deriving reasonable output measures in education, environmental preservation, criminal justice, public assistance, and all of the myriad of other civilian programs not only boggles the mind but also the cost of their development might well exceed the manpower and planning resources available in the entire United States Government. After four years of federal civilian implementation, Budget Director Robert P. Mayo (1969) reported to Congress that

> we are limited ... by our inability to develop output measures that permit inter-category comparison of benefits. For better or for worse, we have no generally agreed upon way of deciding quantitatively whether the nation benefits more by providing greater dignity for the aged ... or by training disadvantaged persons in their early 20's or by making our highways safer or by reducing crime.

The same difficulties of output measures pervade higher education and constitute a major obstacle to meaningful PPBS implementation. This topic is addressed in greater detail in a subsequent paper.

In addition to these almost technical difficulties of organizational structure, measurability and comparability is the far reaching and foundation shaking criticism of PPBS advanced by Aaron Wildavsky (1964) and the pluralistic social scientists [See also Merewitz and Sosnick (1971)]. Allen Schick recently contrasted systems oriented PPBS with the traditional pluralistic, process oriented budgeting system in a thoughtful article entitled "Systems Politics and Systems Budgeting" (1969). In essence, Schick argues that

> In systems budgeting the distinctive element is the analysis of alternative opportunities, while in process budgeting it is the bargaining apparatus for determining public actions ... Process politics (and budgeting), therefore, tends to favor the partisans such as agencies, bureaus, and interest groups, while systems politics (and budgeting) tends to favor the central allocators, especially the chief executive and the budget agency.

Although the process school of budgeting has dominated American politics for the past twenty years, PPBS has obviously had strong administrative and legislative appeal over the past decade. Schick (1969) has suggested that two major reasons for the President abandoning the traditional incremental political process in favor of PPBS were: "(1) a desire for involvement and initiative in program development and (2) an insistence of scrutinizing existing programs." Parenthetically, the same desires for increased ability to direct the courses of action within educational institutions seem to motivate current state and federal interests in PPBS for higher education [Balderston (1971)].

Schick concludes:

> PPBS is an idea whose time has not quite come. It was introduced government-wide before the requisite concepts, organizational capability, political conditions, informational resources, and techniques were adequately developed. A decade ago, PPBS was beyond reach; a decade or two hence, it, or some updated version, might be one of the conventions of budgeting. For the present, PPBS must make do in a world it did not create and has not yet mastered.

However, we should not leave the impression that PPBS has had no impact on federal decision making. As former Deputy Director of the Bureau of the Budget Philip Hughes (1969) stated,

> Program budgeting has had impact on some of the main issues faced by Government. This impact has not always been large, but we have been able to foresee some major decisions that must be made and to have some analysis far enough in advance to make a difference.

Furthermore, the experience with PPBS in the Department of Health, Education and Welfare is particularly relevant to institutions of advanced learning. Dr. Alice Rivlin, former Assistant Secretary for Planning and Evaluating in HEW, pointed out that "PPBS has contributed in HEW to the organization of existing information in more useful ways. Further, the program budget 'made it possible for the first time to see where department resources were going--by major objective, by type of program, by target group, etc.'" [Botner (1970)].[7] We shall return to the organization of data into information in our subsequent discussions.

By the end of 1971 over half of the 50 states have formally adopted PPBS. In 1966, California was one of the first states launched into PPBS just nine months after President Johnson's announcement of the federal PPBS. In his memorandum to the heads of all state agencies, California Governor Brown (1966) directed

> the establishment of a programming and budgeting system within the various agencies of state government to bring all planning, programming, and budgeting activities into an integrated system.

Two years later, Governor Ronald Reagan endorsed the state PPBS system. In asking all departments for five year projections of costs and revenues, he indicated that "This process is an integral part of the Programming and Budgeting Systems, the implementation of which I am very interested in speeding up" [Reagan (1968)]. Consequently, every state agency and

major unit, including the University of California, was required to submit its budget requests in the program budget format. The experience of the University of California in this effort is described in Part II.

PPBS IN POSTSECONDARY EDUCATION

Although faculty and individual researchers have been involved in PPBS through RAND and other external organizations since the early 1950's, institutions of higher education have viewed PPBS as appropriate for themselves only since the mid-1960's.[8] One of the earliest expositions of PPBS for colleges and universities was Williams' monograph prepared for the Commission on Administrative Affairs of the American Council on Education and published in 1966. It is interesting to note several factors in the origin of Williams' study. From the beginning, the major premise of the Williams study was that it is possible and appropriate to transfer the Defense Department's approach to planning and budgeting directly to colleges, universities, and state systems of education. Secondly, the major staff input to Williams' study came from the Institute for Defense Analyses and the RAND Corporation; most of the reviewers were either at RAND or previously employed by RAND. In contrast, the early development of PPBS for defense began almost a decade before implementation by questioning basic principles and inductively constructing a reasonable and consistent view of defense objectives and missions.

Perhaps the staff input and conceptual context predominant in Williams' report led to a proposed program budget format that closely resembled current activities rather than institutional objectives. Williams gives several examples of program budget formats which are

certainly more informative and more useful for decision making than traditional line item or functional budgets. However, his examples of programs are the College of Arts and Sciences, the College of Law, and the School of Engineering which are organizational units and exemplary program elements are departments within a school or college. This activity oriented view of programs and program elements has permeated much of the subsequent development of PPBS for higher education. At the same time, one of the basic tenets of PPBS is that a program element is the smallest divisible collection of personnel and resources the use of which advances the organization towards a given objective. In virtually every case this conflict between an objective oriented program structure and an activity oriented program structure has been resolved in favor of the activity structure. The key to an objective oriented program structure is an acceptable system of output measures--a topic which has received considerable attention recently and which we will discuss later [Balderston (1970), Breneman and Weathersby (1970), Huff (1971), Wallhaus and Micek (1971)].

In 1966, Frank Dilley also advocated the adoption of PPBS by colleges and universities. In his very perceptive article, Dilley recognized that PPBS does not inevitably lead to centralization, which is antithetical to most of higher education. In his words [Dilley (1966)]:

> One last advantage of this kind of new look at university planning is that a new way of budgeting [PPBS] will help insure that decisions are made at the proper level ... Many decisions ought to be decentralized at the same time that the budgeting process provides the information which will make for better centralization of other decisions.

Although Dilley also defines programs in terms of activities and program elements in terms of departments, he did recognize the essential role of output measures and suggested the readily available indices of student majors, student credit hours, research publications, student

advising, committee assignments, SAT and GRE test scores, etc. Furthermore, Dilley realized that the program budget format performs two important functions: "it enables the gathering of the information which is essential to good decisions, and it builds specific projections of the future into the planning process." Not only should total input and output information be included in the PPB System, but the form of these data should also facilitate valid comparisons of costs and benefits.

These two concepts of program oriented data bases supported by analytical and projective techniques and inter-institutional data comparisons are the keystones of the National Center for Higher Education Management Systems (NCHEMS). Conceived in 1967 and 1968 by statewide planners and institutional executives, NCHEMS was originally funded as the Management Information Systems Program of the Western Interstate Commission for Higher Education (WICHE) in 1969. However, because the scope of activity was much broader than just management information systems the program became national and changed its name to the Planning and Management Systems Division of WICHE in 1970. Then in 1971, the U.S. Office of Education designated the program a national center with multi-year institutional funding. NCHEMS is now the major focus of PPBS related activities in North America.

By the end of 1971, NCHEMS has prepared, with substantial input from governmental agencies and educational institutions in all its decisions, the following major products:

- a program classification structure which categorizes the activities of an institution into the seven major programs of instruction, sponsored research, community service, academic support, student support, institutional support, and outside enterprises. [Gulko (1971)]
- a dictionary of data element definitions covering the areas of

students, courses, staff, finances, and facilities. [Thomas (1970)]

- a series of manuals dealing with planning for and analysis of physical space in colleges and universities. [Mason (1971)]
- a manual for classifying and reporting both academic and non-academic personnel. [Minter (1971)]
- a computer based projection model to estimate the costs of alternative program decisions, called Resource Requirements Prediction Model. [Gulko and Hussain (1971)]
- a preliminary inventory of educational output and activity measures for use in PPBS. [Huff (1971), Walhaus and Micek (1971)]
- an extensive training program including annual national conferences and executive publication series. [Minter and Lawrence (1969), Lawrence, et.al. (1970), Farmer (1970)]

In addition, NCHEMS has a number of projects under development which will be completed in the coming months. These projects include: a student enrollment projection technique, a faculty activity measurement technique, procedures for exchange of information among institutions, indirect cost allocation techniques, a project for statewide planning tools, and new training programs.

In 1968 the Ford Foundation funded several research and development efforts in North America to improve the technology of resource allocation in higher education. Projects were funded at MIT, Princeton University, University of Toronto, University of Georgia, Stanford University, and the University of California. Two years later a similar research unit was funded by Ford at NCHEMS. Each of these projects had a somewhat different focus; of primary importance to the development of PPBS was the program budgeting implementation effort at Princeton under the leadership of then Provost William Bowen,[9] the advancements in analytical data base management achieved by Stanford's Project INFO under the direction

of Michael Roberts, and the general resource allocation analyses conducted at Toronto, NCHEMS and the University of California [Judy (1970), Ford Research Program (1971)].

In late 1967 the Carnegie Corporation funded the extensive five-year study of higher education by a group of distinguished scholars led by Clark Kerr, former president of the University of California. The Carnegie Commission on Higher Education has produced several dozen Commission reports and commissioned monographs; while none of these pertain directly to PPBS in higher education, many are very useful for general policy orientation. In particular, the report by Earl Cheit (1971) on The New Depression in Higher Education which detailed the financial difficulties of an indicative sample of 41 American institutions of higher education, and the monograph by June O'Neill (1971) on productivity gains (or their absence) in higher education are especially interesting tc the economic aspects of institutional planning.

On the international level and beginning in 1967 and 1968 the Organization for Economic Cooperation and Development (OECD) asserted a leadership role in the development of PPBS for higher education in Western Europe. One OECD project has been devoted to "budgeting, programme analysis and cost-effectiveness in educational planning" [OECD (1968)] while another has focused on university planning and management models [OECD (1969)]. In an effort roughly analogous to NCHEMS, OECD has been working with the pilot implementation of PPBS and analytical models at six institutions in Western Europe. To date these efforts are still developmental and no complete college or university implementation of PPBS has been achieved in either Europe or North America.

Parallel with this growing interest in PPBS for educational institutions has been the expansion of the role and responsibilities of

statewide educational planning agencies in the United States. This trend was correctly analyzed and anticipated by Lyman Glenny in 1959 and statewide planning has come to play a major role in educational resource allocation in over one-half of the fifty states.[10] These statewide coordinating and governing agencies developed partly in response to the requirements of the 1963 Higher Education Facilities Act which made facility construction grants available to institutions only through a statewide planning agency and partly in response to the political pressures for improved resource management. Currently U.S. higher education is a twenty billion dollar enterprise, not counting the contributed time of students, and most of these funds come from state governments who are becoming increasingly interested and concerned with the use of these resources. This in turn has constituted a major source of pressure for PPBS implementation in the States of California, Florida, Hawaii, Illinois, Michigan, and Washington to name just a few. This interest has also shaped the development of statewide PPB Systems including higher education in many of these states.

Development of Educational Planning Models

Fortunately, the tools necessary to support systems analysis were developed concomitantly with the PPBS evolution described above. Institutional cost models were first developed in 1965 and 1966 [Judy and Levine (1965), Weathersby (1967)]. While these early cost models were somewhat primitive compared with the detailed and flexible resource planning models available today, they were holistic and systems oriented from the very beginning. An institutional cost model essentially embodies the educational production technology of a college or university and estimates

the resource requirements associated with either expansions along the production surface, e.g., increasing student enrollments, or adopting new educational configurations, e.g., a change in faculty workload offset by increased use of computer aided instruction. In general these cost models are descriptive, rather than prescriptive, and accept either the recent historical experience or a planner's judgment of the educational technology as the validity of and justification for continuing the same patterns of instruction. The past is not always efficient; in fact, in higher education there is good reason to believe that the past experience will not be efficient because there is no economic profit motive to drive institutions towards efficiency. However, the slow evolution of instructional patterns in educational institutions still exceeds the rate of introduction of economic efficiency incentives and, therefore, the recent past will in all probability continue to be an adequate predictor of the future.

Subsequent to the development of institutional cost models was the design and construction of many special purpose analytical tools. These tools run the gamut from data analysis procedures to projective techniques to optimizing models, from a single equation with two variables to large scale systems with thousands of variables, from simple checklists to desk calculator models to giant computer models requiring 5 million bytes of core memory storage, and from Australia to North America to Great Britain and Western Europe [Weathersby and Weinstein (1970)]. The subjects or foci of these tools also cover the spectrum of objectives and activities of educational institutions: forecasting student enrollment; measuring faculty activity; scheduling instructional facilities; forecasting revenues; relating financial aid, student quality and student demand; calculating capital construction needs and the costs of alternative routes of

campus expansion; derivation and analysis of unit costs; medical school curriculum and staffing requirements; manpower production and migration; and literally dozens of other subjects.

Summary

In the past seven years, there has been a tremendous interest in improved planning and analysis in higher education. This has led to the voluntary adoption of PPB Systems (and in some cases a state requirement for PPBS) and the development of new analytical tools. In general these PPBS efforts have been a transfer to higher education of an existing technology which was largely developed for the Department of Defense; the program structures have focused on activities and not objectives; the mathematical models have dealt with costs far more than benefits. But crude as these methods may appear, they represent significant technical advances in educational planning and management.

However, we must also consider the political and institutional context of higher education planning and management and the highly political role of information. Making administrative objectives explicit may increase dissatisfaction both internally and externally because everyone can no longer seek solace in his own, mutually inconsistent, interpretation of institutional objectives. Experienced administrators are only too aware of the subtle problems of maintaining institutional cohesion--problems which are far from adequately dealt with in present models.

Furthermore, displaying institutional cost and activity data in great detail enables, or at least tempts, state and federal officials to exert their influence on very low level decisions. PPBS does not <u>necessarily</u> lead to increased centralization of decision making but already existing

political pressures towards centralization are usually reinforced by the availability of data and analysis. Resolving major resource allocation and policy choices always generates some opposing political forces; PPBS gives all sides more information and, therefore, more power--which can escalate the confrontation [Hitch (1969)].

In other words, PPBS can help administrators, faculty and students in higher education by improving their understanding of their organization, providing better estimates of the impacts of various decisions, organizing and systematizing institutional information, and providing a more comprehensive view of the total operating status of the institution both now and in the future. On the other hand, PPBS requires increased resources for planning, may increase instead of decreasing the level of institutional and political stress, and provides an apparent means for increased central control. It is impossible for us to predict the outcome of implementing PPBS in any one institution, but we can describe the results of developing PPBS within the University of California and that is the subject of Part II.

FOOTNOTES

[1]See "Planning-Programming-Budgeting System: A Symposium," Public Administration Review, Vol. 26, December 1966; "A Symposium,--Planning-Programming-Budgeting System Reexamined: Development, Analysis, and Criticism," Public Administration Review, Vol. 29, March/April 1969; Botner (1970).

[2]Located at the Western Interstate Commission for Higher Education in Boulder, Colorado.

[3]Quoted liberally from Keller (1969).

[4]For a more complete discussion of PPBS, see Novick (1967). For a systematic definition of terms, see the Program, Planning, Budgeting and Systems Analysis Glossary, Washington, D.C.: U.S. General Accounting Office, January 1968.

[5]For an extensive further discussion of cost-benefit analysis see Grosse (1964).

[6]For a discussion of PPBS in the Pentagon see Enthoven and Smith (1971) and Yarmolinsky (1971). A thoughtful review by John Walsh of both of these books appeared in Science (1971).

[7]For a more complete discussion of Dr. Rivlin's view of programmatic planning see her Systematic Thinking for Social Action (1971).

[8]Fielden (1969) surveyed the implementation of PPBS in American colleges and universities and assessed its potential for Great Britain. Private college implementation of PPBS is discussed by Parden (1969, 1971). Peterson (1971) surveys the recent literature of PPBS in higher education.

[9]See the Princeton Priorities Committee Report (1971) and Bowen's assessment of the financial plight of private colleges and universities in Bowen (1969).

[10]Contrast Glenny (1959) with Glenny et.al. (1971). Also see Berdahl (1971) and Glenny and Weathersby (1971).

PART II

THE UNIVERSITY OF CALIFORNIA EXPERIENCE WITH PPBS

Introduction

As of 1971, PPBS as a formal system of justifying and negotiating resource allocations by the State government to the University of California, and as a system of internal resource distribution and priority allocation, has turned out to be relied on only to a quite limited degree. Some of the intensive PPBS design efforts of earlier years continue to undergo further development, but the pressures of events and of differing perspectives have led toward other forms of analysis and other approaches to resource decision and, to a considerable extent, away from the complete implementation and usage by all parties of a PPBS structure as originally envisioned.

A recounting of this recent history may be instructive to those who are "believers" and also to those who, mistakenly in our view, have held to the proposition that all must be intuition in the politics and policy formulation of budgeting and resource allocation in universities.

The specific history of PPBS in the context of the University of California and of California State government began with parallel efforts in both places during the 1966-68 period to commence design and develop appropriate new concepts for PPBS. In both the State government and the University there was a great deal of foundation to build from. In the early 1960's the University had overhauled its methods of budget preparation and presentation to the State and had made parallel improvements of its internal budget administration.

Classical "line item" or object-class concepts were superceded by a "function and performance" schema and by the use of ratios relating many types of resource requirements to workload indicators. Budgeting for

capital outlay continued to be done by assembling the cost magnitude for each capital project, but underlying space standards and activity statistics were heavily used in determining what projects had priority and in justifying components of the capital budget. Both the capital budget and the operating budget were constructed and presented to the State in terms of a multi-year horizon: the last year of actuals, the current budget year in progress, the forthcoming year's proposed budget (the operative budget for State government decision), and projections beyond the operative year for four or five years into the future, assuming continuation of the path of enrollment growth and institutional development. A thorough procedure of internal hearings, review and analysis at the University's campuses and in the President's office led up to the President's adoption of a proposed budget for presentation and adoption by the University's governing board and transmittal to the Executive Branch of the State government. During the 1960's, up to the State's 1967-68 budget decision, the difference in total magnitude between the University's proposal (the "Regents' Budget") and the operating budget allocation finally adopted by the Legislature and signed into law by the Governor was typically very small--in the range of one or two percent.

For its part, the State government already had a highly regarded, systematic budgeting process. In the Executive Branch, the Department of Finance's Budget Division performed detailed analysis and review of agency proposals and assembled the overall Governor's Budget for presentation to the Legislature. Other groups in the Department of Finance developed a base of descriptive statistics and demographic forecasts for the use of the State government and its agencies, and analytical groups worked for the Director of Finance on pending longer-range issues of

State programs and resource priorities. California had also developed a uniquely powerful and professional capability for fiscal, budgetary and policy analysis for the Legislature. This was the Office of the Legislative Analyst, who worked for the Joint Legislative Budget Committee. The Legislative Analyst, A. Alan Post, has held this post for many years and is universally regarded as an incisive, even-handed, and courageous public servant. Alan Post's staff provides to the Legislature early in each annual session a comprehensive analysis of the revenue and expenditure components of the Governor's Budget, and his staff and Department of Finance staff are both present at all budget hearings before committees of the Legislature and for testimony on important pending bills.

Both the Department of Finance, with a PABS (Programming and Budgeting System) group formed to develop new program budgeting approaches, and the Legislative Analyst's office, devoted considerable effort from 1966-67 on to formulation of next steps in the improvement of the State's budgetary process. The University received word that it would be expected to provide, for the 1969-70 proposed budget, both an "old format" and a "PPBS-format" budget. The latter was achieved by setting forth in computer code a "cross-over" program which would translate all the budget magnitudes of the 1969-70 "function" budget into new program budget categories, by utilizing standard rules of reallocation. The new format was used in preliminary form for the 1969-70 budget submission and then, in the full cross-over form, a submission was provided to the Department of Finance in April, 1969. This was a preliminary version of the fiscal year 1970-71 budget, taking the overall magnitudes for that and, on a projected basis, subsequent years through 1973-74 from the University's Long-Range Fiscal Plan. These magnitudes were then distributed over major programs and

supporting programs according to a program classification system, dividing academic operations into twenty-nine disciplines and professions.

The document contained a considerable amount of program description and discussion in each of six major program areas: instruction, sponsored research, public service, libraries, administration, and supporting services. Level-of-activity indicators were described and some figures were presented, and there was preliminary discussion of the vexing question of output measurement for each program area.

In the Spring of 1969, one of the present authors (Balderston) was optimistic about the further progress of PPBS in a paper presented to a conference held by OECD.[1]

All this would appear to imply that the President would put a proposed 1970-71 budget in a more extended program budget format in the Fall of 1969 for the approval of the University's Regents and for transmittal to the Governor of the State. Instead, the well-established and historically grounded function-and-performance budget approach was used, and it is instructive to see why.

The Department of Finance--the Governor's budgeting agency--had instructed the University administration to show how it would operate in 1970-71 at three alternative, specified dollar levels of State appropriation, of which the lowest was far below the 1969-70 budget level. The most familiar and historically comparable interpretation of the implications of these alternatives could best be obtained by continuing to use the old format.

More than this, the University's own budget staffs on the nine individual campuses, and the staff in the Office of the President responsible for assembling, analyzing, and documenting the budget, were so

hard pressed with work in responding to the State's demands that there was no choice: the budget battle came first, and development of new concepts and procedures had to be set aside. While the appropriation from the State of California was only part (about 45%) of the total operating resources used by the University, it was and is by far the most significant part; it pays for the basic salaries of the faculty and instructional staff, for the bulk of administrative salaries, for the library collections and for maintenance and operation of the academic plant. Large amounts of other funds come in from student fees, mainly used for student services; from research grants and contracts, used for research equipment and staff salaries, other than basic faculty salaries; and from services rendered, as in the teaching hospitals of the medical schools and the living quarters provided to students in the dormitories and apartments operated by the University. But the academic capability of the University depended first and foremost on the support provided by the State government of California. Hence, the manner of presentation of the University's budget depended solidly on the attitude of the State government about both procedure and substance.

The outcome of these relationships in the three fiscal years, 1969-70, 1970-71, and 1971-72 was clear enough: the State's appropriation enforced by the Governor with his line-item veto, remained almost exactly the same in current dollars, while inflation took its toll on the spending power of each dollar and while, also, enrollment in the University rose by several thousand students each year. In contrast with these budgetary results, the University proposed successively larger annual budgets, using its budgetary standards for "workload," together with the recognition of cost inflation and the inclusion of some proposals for new programs. The

gap between the University's conception of budgetary needs and the apparent intentions of the Executive Branch of California was large and increasing. The budgetary arguments and testimony before legislative committees were dominated by very immediate issues: how much of a decline in the faculty staffing standard relative to enrollment should the State enforce? Should the State-supported summer term, which had been initiated in order to accommodate increases of enrollment by intensive year-round use of academic facilities, be dropped (as it was in the 1969-70 budget) in order to permit the resources the State was willing to appropriate to be used to support operations in the regular academic year? How far should classic approaches of input control (in Governor Reagan's words, "cut, squeeze and trim") be used to cut down the number of State dollars made available to the University? And, finally, in what ways, apart from seeking to reduce the rate of University expenditure for academic operations, could the State goad the University into shifting University costs from the State budget to other sources of funding--particularly students, through forced increases in student fees and the use of some of these fees for academic purposes?

These issues were the domain of argument in the budget years of 1969-70 to 1971-72, and it is not surprising that the mechanics of an elaborate PPBS system would have been largely irrelevant to them. A great deal of hard analysis, some of it taking account of long-range as well as very immediate considerations, was done by the University administration and by the staffs of the Executive and Legislative Branches to support their respective positions. But the crucial issue seen by the Executive Branch of the State government was dollar input control, not the balancing of resource inputs against the performance achieved, and the arguments

each year revolved around budgetary components not much related to the fine detail of a discipline-by-discipline layout of educational operations.

Another indicator of this input-control focus was the lapsing of interest in multi-year budget projection and presentation. The Governor's budgets for the 1969-70 and 1970-71 fiscal years did not contain forward projections beyond the target year of budgetary decision, and by the time of the 1971-72 budget presentation, the University administration did not include the previously customary five-year horizon, of which the target year had been the first year with the future implications of the University's resource needs indicated beyond it.

At the September and October, 1971, meetings of the University's Regents, the President brought forward his operating budget proposals for fiscal year 1972-73. These did not include forward projections beyond the target year. Also, they were presented in the form of three alternatives: (a) an austerity level; (b) the President's recommended level; and (c) a budget based on the budgetary standards underlying the 1971-72 budget proposals adopted by The Regents of the University (but not approved by the Executive Branch when it presented its 1971-72 budget). The 1971-72 budgetary base was $337 million of State appropriation. The "austerity" budget alternative was constructed by adding to this a series of items to take care of increases in fixed costs (additional employee costs other than general salary increases, such as funds to finance the higher salaries of promoted employees and to finance mandated increases in unemployment compensation and health insurance coverage). These totaled $11.5 million. Next, $4.3 million was added to compensate for price increases in commodities and utilities purchased by the University. Finally, a series of funding adjustments totaling $9.5 million was added.

To this was added $15.3 million for very minimal enrollment-related increases. The resulting austerity budget was therefore $40.6 million higher than the 1971-72 budget, without taking account of other enrollment-related budgetary needs and a few very high priority new programs.

The President's recommended 1972-73 budget was $397.4 million, $19.7 million higher than the austerity alternative. It provided slightly more generous allowances for enrollment-related resource needs, and also included $7.4 million for restorations and a few new programs. The third and highest budget alternative called for $16.6 million more than the President's recommended level.

After the Regents' budget was adopted, a further adjustment in the 1972-73 budget proposal to the State was made to revise projected 1972-73 enrollment on the basis of actual Fall 1971 enrollments. Table A, taken from the 1972-73 Governor's budget, shows the 1972-73 budget for current operation in the traditional functional and performance center format. Table B, also taken from the 1972-73 Governor's budget, shows these magnitudes in the State's program budget format. Our purpose here is to illustrate the difference in functional and program budget formats and not to plunge the reader into detailed numerical comparisons.

As this article is written, the outcome of the 1972-73 budget cannot be predicted. The Governor's budget, forwarded to the Legislature in early January, 1972, contained recommended increases totaling $18.7 million beyond the University's 1971-72 budget level, as well as general salary increases for staff personnel, totaling $20.7 million. The Governor's budget will serve as the starting point for legislative consideration of the budget, and it is this level that the Governor is likely to defend by exercising his veto of legislative appropriations at higher

Table A

FUNCTIONAL BUDGET

University of California 1970-71 to 1972-73

PROGRAM REQUIREMENTS

	70–71	71–72	72–73	1970–71	1971–72	1972–73
Instruction and Departmental Research:						
General campus	11,105.61	11,159.23	11,188.23	142,343,529	148,260,450	148,817,076
Health sciences	2,650.56	3,065.86	3,195.86	43,755,713	49,751,276	53,053,014
Summer session	329.75	379.83	407.33	4,188,461	4,844,967	5,195,389
Organized research	3,102.43	2,527.51	2,540.26	43,724,110	41,963,812	41,986,049
Extension and campus public service	2,100.35	2,033.17	2,077.92	32,209,086	32,572,399	33,288,350
Organized activities	706.21	717.95	726.70	6,887,578	11,693,112	11,835,722
Teaching hospitals	8,147.76	7,430.11	7,430.11	85,693,301	95,766,761	104,188,169
Libraries	2,232.07	2,041.54	2,041.54	26,483,253	26,556,633	26,558,630
Maintenance and operation of plant	3,190.86	3,002.42	3,002.42	33,096,922	34,580,539	34,582,021
Administration and services	4,661.88	5,134.36	5,109.16	38,749,348	41,917,641	41,211,947
Student services	2,199.29	2,165.80	2,193.80	26,912,550	26,838,713	30,206,162
Staff benefits	–	–	–	30,490,603	30,656,517	30,099,517
Provisions	–	–	–	–	–1,654,887	9,104,882
Auxiliary enterprises	1,757.25	1,915.62	2,082.62	37,582,924	45,888,226	49,887,111
Student aid	–	–	–	6,725,156	6,276,004	7,932,282
Special regents' program	–	–	–	14,549,081	16,289,340	16,336,000
TOTALS, BUDGETED PROGRAMS	42,184.02	41,573.40	41,995.95	$573,391,618	$612,201,503	$644,292,261
Reimbursements:						
Nonstate University General Funds				–31,085,892	–37,891,704	–29,634,530
University Restricted Resources				–205,000,208	–236,235,525	–258,585,731
NET TOTALS, STATE FUNDED PROGRAM				$337,305,518	$338,074,274	$356,072,000
State General Funds				*337,079,264*	*337,091,074*	*355,800,000*
California Water Fund				*99,872*	*100,000*	*100,000*
Motor Vehicle Fund				–	*750,000*	–
Real Estate Education, Research and Recovery Fund				*126,382*	*133,200*	*172,000*

UNIVERSITY OF CALIFORNIA FISCAL PROGRAM

Budgeted Program:			
State Funded	337,305,518	338,074,274	356,072,000
University General Funds	31,085,892	37,891,704	29,634,530
University Restricted Funds	205,000,208	236,235,525	258,585,731
Totals, Budgeted Program	$573,391,618	$612,201,503	$644,292,261
Extramural Programs:			
Sponsored and Other Restricted Activities	215,338,633	221,097,376	234,439,475
Major Atomic Energy Commission Supported Laboratories	271,760,419	271,761,000	271,761,000
GRAND TOTALS, ALL PROGRAMS	$1,060,490,670	$1,105,059,879	$1,150,492,736

SOURCE: Governor's 1972-73 Budget, State of California, Sacramento, California, January 1972, p. 1075.

Table B

PROGRAM BUDGET

University of California 1970-71 to 1972-73

SUMMARY OF PROGRAM REQUIREMENTS	MAN-YEARS 70-71	71-72	72-73	ACTUAL 1970-71	ESTIMATED 1971-72	PROPOSED 1972-73
BUDGETED PROGRAMS						
I. Instruction	13,734	13,635	13,822	$203,299,000	$201,864,000	$211,072,000
II. Organized research	2,939	2,564	2,577	45,707,000	42,003,000	42,898,000
III. Public service	1,960	2,170	2,215	32,012,000	35,405,000	36,335,000
IV. Academic support	11,394	10,639	10,648	133,022,000	153,525,000	162,993,000
V. Student services	3,708	3,832	4,027	72,499,000	84,310,000	94,178,000
VI. Institutional support	8,449	8,733	8,707	86,852,618	95,094,503	96,813,261
TOTALS, BUDGETED PROGRAMS	42,184	41,573	41,996	$573,391,618	$612,201,503	$644,292,261
EXTRAMURAL PROGRAMS						
VII. Sponsored and other restricted activities				$215,338,633	$221,097,376	$234,439,475
VIII. Major Atomic Energy Commission supported laboratories				271,760,419	271,761,000	271,761,000
TOTALS, BUDGETED AND EXTRAMURAL PROGRAMS				$1,060,490,670	$1,105,059,879	$1,150,492,736
SOURCES OF FUNDS—BUDGETED AND EXTRAMURAL PROGRAMS						
University of California—General Purpose Resources:						
State General Funds				*$337,079,264*	*$337,091,074*	*$355,800,000*
University Funds				*31,085,892*	*37,891,704*	*29,634,530*
Restricted Funds:						
Real Estate Education, Research and Recovery Fund				*126,382*	*133,200*	*172,000*
California Water Fund				*99,872*	*100,000*	*100,000*
Motor Vehicle Fund				–	*750,000*	–
University Funds				*295,060,208*	*236,235,525*	*258,585,731*
Extramural				*487,089,052*	*492,858,376*	*506,200,475*

SOURCE: Governor's 1972-73 Budget, State of California, Sacramento, California, January 1972, p. 1075.

levels. After three years during which no general salary increase funds for the faculty were appropriated by the State, the Governor's 1972-73 budget does call for a general faculty salary increase of 7.5% compared with a 5% increase recommended for non-academic personnel.

PPBS and the Multi-Campus Structure of the University

The University of California has nine campuses and a large number of other loci of activity (agricultural field stations, research stations, etc.). The budgets just discussed are presented to the State in a single integrated form for all nine campuses, and the State's appropriation is not earmarked to individual campuses. The President's budget presentation to The Regents does customarily contain detailed enrollment figures for each campus, as well as campus by campus data on number of faculty positions. Additional campus by campus detail is made available to the technical staffs of the Executive and Legislative Branches of the State government as they request it.

As progress was under way in the development of budget data and activity- and output- indicators according to the breakdown of academic operations into twenty-nine disciplines and professional curriculum areas, it was anticipated that this format would permit examination of new kinds of questions, e.g., should the aggregate commitment of the University in the major professional fields be increased relative to that in the humanities?

The individual campus administrations did proceed with aggressive efforts to assemble more detailed information on discipline-by-discipline enrollments and resource allocations, but there were good reasons, rooted in the substantial decentralization of operating responsibility to the

individual campus, for the campus administrators to resist intrusive controls by the President's office on resource allocations within the campus. Thus, the President's office has confined itself to allocations of additional resources (or to cuts in resources) according to general resource categories (e.g., number of faculty positions, or dollars for library acquisitions) rather than making specified allocations on a discipline-by-discipline basis. Yet this is what could have been implied by the initial approach on the 1969-70 program budget, which did rely heavily on a discipline-by-discipline breakdown.

The New Situation: Revised Targets for the Future, and Program Review

The trajectory of the University's resource planning in the 1960's was determined by two things: the character of its mission, as understood generally from a century of history and as set forth in the California Master Plan for Higher Education, promulgated in 1960-61; and the quantitative characterization of this mission in the University's Growth Plan, of which the first version was adopted in 1960 and an up-dated version was adopted in 1966.

The designers of the State's Master Plan foresaw a massive expansion of California higher education. The private, independent colleges and universities were not expected to absorb a significant fraction of this growth, so the Master Plan laid down general principles of allocation between the two-year public colleges; the degree-granting State colleges (which offered the BA degree and some Master's degree programs); and the University of California. The University had exclusive jurisdiction over doctoral programs and the major professions (including medicine and law), and it was also to provide continued enrollment opportunity on a selective

basis to the top one-eighth of high school graduates as well as accepting transfer students who did well in junior college.

For public higher education as a whole, the driving variable was enrollment growth, based on demographic projections that included both native and in-migrant growth components and on further increases of the participation rate in higher education by those of college-going age.

The University, with the State government's approval and financial backing, established three entirely new campuses (at Irvine, Santa Cruz, and San Diego), broadened the missions of two others (the Riverside and Davis campuses) and planned for very large growth and also for an increasing percentage of graduate enrollment even while a large absolute increase of undergraduates was to be accommodated. The 1966 Growth Plan extended the time horizon for this trajectory and elaborated it in more detail.

Then followed the first set of events which fractured the assumptions of the Growth Plan: the student upheavals of the mid-1960's and the public clamor in response; the 1966 election of Governor Reagan in which the University was a major political issue, and the immediately subsequent firing of President Clark Kerr, during whose presidency the California Master Plan and the related University growth targets and new campus developments had moved vigorously; the budget years from 1967-68 through 1969-70, with the discouraging outcomes already discussed.

By January, 1970, President C. J. Hitch found it essential to call for a reassessment of the University's growth plans, and he established a University Growth Plan Review group. This task force, headed by Harry R. Wellman, The Vice President of the University Emeritus, examined with special care the population statistics upon which earlier long-range

enrollment projections had been based. The 1970 Census of Population confirmed interim guesses, in that it showed a much lower growth trend for the future in the number of college-age people in California. In-migration to the State, which during the 1950's and early 1960's had been substantial (200,000 - 300,000 persons per year) had stopped, and the number of eighteen year-olds in the U.S. and in California was now shown to reach its absolute peak in the latter 1970's and to decrease thereafter.

Meanwhile, for the first time since the end of World War II, a nationwide oversupply of new Ph.D.'s--young recruits to college teaching and governmental and industrial research--was becoming very evident and casting doubt on plans for continued expansion of doctoral training. The national question was whether this was temporary--induced by a combination of the 1969-71 business recession, the decline in Federal funding of R&D, and the hiring adjustments being made by academic institutions facing short-term fiscal problems from inflation--or whether it was only the beginning of a protracted period of oversupply. Chancellor Allan Cartter of New York University delivered a highly influential paper to the December, 1970 annual meeting of the American Association for the Advancement of Science.[2] In the mid-1960's he had gone on record discounting the enthusiastic predictions of a need for long-term accelerating growth of new doctorates. In December, 1970, he updated his projections and showed a widening gap between the number of new doctorates who would be needed for academic posts from 1970-85 and the much larger number who would be produced if current trends continued.

No one university, by itself, needs to consider these national market projections as controlling on its own individual plans. But the large size of the University of California as a doctoral institution (in 1970

it awarded approximately 6.5 percent of all doctoral degrees in the U.S.) and its public funding and responsibility compelled some re-thinking.

The Growth Plan Review Task Force gave its final report to the President of the University in June, 1971. Excluding medicine and the other health sciences, for which a separate long-range plan had already been submitted to the State government, the report showed that, as compared with the 1966 Growth Plan, in 1970-71 the enrollment, totaling 107,000 students on the general campuses of the University was approximately 2,000 students below what had been projected for that year in the 1966 plan. But the composition of this enrollment displayed an important shift: undergraduate enrollment was above the 1966 Plan's target by 5,700 students, while graduate enrollment was below target to the extent of 7,800 students. The report contained new, proposed official enrollment projections for the years through 1980-81. These reflect the changes in demographic considerations discussed earlier, which in an American state university have their most obvious implications for undergraduate enrollment but which also affect the horizon of graduate enrollment growth, particularly for the doctoral training of future college and university faculty whose academic employment, in turn, will be dependent on higher education enrollment.

The range of uncertainty specified in the report was greater for graduate than for undergraduate enrollment. The report showed projected 1980-81 undergraduate enrollment, subject to the availability of adequate resources for faculty, staff, and facilities, of approximately 105,000 (as against 73,000 in 1970-71) and graduate enrollment in the same year of 34,000 (as against 25,000 in 1970-71). Within these general-campus totals, the enrollment growth targets of some individual campuses are

lower than had been anticipated in earlier plans. The report also observes that "...graduate enrollments have been allocated to the campuses in such a way as to provide for the planned expansion of existing professional schools and for the establishment of some new professional schools. Final decisions on the locations of such new schools may require some adjustment in graduate projections." About 11,700 of the 1970-71 graduate enrollment was in professional degree (as against Ph.D.) programs, and it was the qualitative recommendation of the report, although no specific details were given, that graduate enrollment growth be concentrated in Master's degree and professional-degree programs and not in further expansion of Ph.D. training.

The Growth Plan Task Force Report was not formally adopted; it was discussed by the President with the University's Board of Regents and has been distributed to campus and faculty agencies for further critique and review. The sensitivity of the campus administrations and faculties to planned enrollment targets is obvious and understandable, for the opportunity to plan for growth of desired program areas is in a real sense a mandate for the future, and the implicit obligation to take enrollment in areas of less interest is an implicit burden.

This Growth Plan Report has not (as of the end of 1971) been officially adopted by the University. When a new Plan is adopted, with whatever adjustments come out of the review process, this cannot be more than approval "in principle" because the ability to make the plan happen is contingent on future funding decisions by the State government. The constitutional and political situation in California, and in State governments generally in the U.S., is that multi-year funding commitments cannot be made and there is little desire to make them. Thus, while the State

authorities may want to know in considerable detail what the University intends as a direction for the future, the actual consideration of what budget to allocate will come up annually.

This means that multi-year plans have a fundamentally different status in the University of California and most other American state universities than they do in the United Kingdom, where definitive action on allocations is taken by the University Grants Committee for a five-year interval after the British Parliament has voted a quinquennial budget. The latter system is said to suffer from rigidity because budgetary decisions cannot be re-opened for modification if a new situation arises within the five-year period; but it does offer the assurance of a multi-year budgeting horizon, which the California system does not.

Growth plans and long-range fiscal plans or projections can be used to convey a general, or macro-framework for a university over some slice of future time, but the resources absorbed and the work accomplished also need to be considered in terms of organizational units and academic programs. Major new programs requiring the formation of a new school or college, e.g., a new law school or a new medical school, at a campus of the University must go through several steps of review and approval in the University of California. The administration of the campus concerned, and the pertinent committees of the Academic Senate (the faculty organization) must support a proposed new school and propose it to the central administration. The President's office reviews it and, if it approves, proposes it for approval to the University's governing board, and it also reports to the California Coordinating Council for Higher Education the intention to establish the new school and requests the advisory approval of that body. Finally, if the proposal passes all these hurdles, it is

put into the University's proposed budget for an upcoming fiscal year and must survive scrutiny by the Executive and Legislative Branches of the State government in order to receive budgetary support as a "new program."

As an illustration of this process, new schools of engineering were proposed at two campuses of the University in the late 1960's. Because of concern whether additional centers of engineering education were needed in the University and at several State colleges, the Coordinating Council engaged a prominent academic consultant (Frederick Terman, retired Provost of Stanford University) to prepare a report on the subject. Terman concluded that the existing engineering schools at private and public institutions throughout the State could accommodate efficiently whatever expansion might be in prospect and that new centers of such training did not need to be established. The Coordinating Council adopted the Terman report, and the University did not initiate the two new engineering schools.

The process of review and approval is less complicated if a new type of degree is not to be offered or if a wholly new school or college is not to be formed. Wherever a new degree program is contemplated by a campus or a new academic department is to be organized, the campus administration must present the proposal to the President for review and approval. During the rapid expansion of the University until the late 1960's such approval was generally forthcoming so long as the campus had authority to offer the level of degree in question, and had indicated its expectations of initiating the degree program in its academic plan, had the space for the program and could absorb the costs of the degree program within "normal" budgets. The overall budget was expanding, and the intention of the University in that expansion phase was to initiate new departments and new programs at a vigorous rate.

The unfolding pattern of severe resource constraint made it necessary to find new ways to face the issue of program review and priorities, just as it had proved necessary to re-examine questions of overall growth. But, in most instances there was not compelling advice external to the University against new programs, as there was in the example of the new engineering schools. The issues needed to be raised and settled within the scheme of internal resource allocation and academic priorities of the University itself.

The first step taken in the central administration was to consolidate, in Spring 1969, into one Program Review Board advisory to the President, the work previously done by two separate bodies--the Capital Outlay Review Board and the (operating) Budget Review Board. This consolidation emphasized the articulation between new capital outlay priorities, with their lead-time of three or more years to completion of academic buildings once approved and funded, and operating budget commitments for the new or expanded programs which would occupy the additional facilities on a campus.

The more fundamental problem, however, was to determine both the substance and the procedures for mediating between what the campuses wanted in a multi-campus institution, and what the University overall could afford and justify in resource priorities. The University had evolved into a decentralized operating structure with central coordination on the overall budget and on Universitywide policy standards in those areas where uniformity was essential. Operating decentralization had been validated by a series of presidential directives in the summer of 1966, giving the campus chancellors wider discretion over personnel decisions, budget controls, and a variety of other issues. There were

good reasons for these moves toward operating decentralization--placing the power to decide closer to the flow of problems and events--but the effect of the decentralization was to call into question the assertion of central review and decision in areas of budget and academic priority.

To this was joined the reverence for the concept of the "general campus." Except for the University of California at San Francisco, which was to remain specialized in the health professions and associated areas of science, it was decided in the early 1960's not to give each campus a limited or specialized mission, but to consider all of them to be "general campuses." Each campus could properly have its own mode of academic and administrative organization, within general University rules and policies, but all of the campuses were expected to offer the doctorate in a broad range of fields and to have some array of professional schools and degree programs. The archetypical general campuses were at Berkeley and Los Angeles both of them large and both possessing a broad range of graduate academic and professional programs. The remaining six campuses, at various stages of their own growth, did not necessarily want to imitate the administrative styles or the labyrinthine departmental organizations and complexities of the two largest campuses; but they certainly aspired to a substantial broadening over time in the composition and balance of their own individual academic and professional programs. Adoption of the general campus concept meant that there were no natural barriers of campus-by-campus specialization in the competition for adoption of new programs.

As seen from the vantage point of the administration, faculty and students of one campus, the problem was to achieve and maintain vitality and balanced composition across a variety of disciplines and professional degree program areas. On the newer and smaller campuses, especially, it

was and is considered essential to keep these program aspirations alive. Yet, from the standpoint of the University as a whole, there are three stubborn issues: (1) available resources have not increased proportionately with enrollment growth; (2) program duplication and proliferation are difficult to justify externally and are probably inefficient internally in a climate of severe resource constraint; and (3) the overall commitment of the University to each program area may need to be considered at the time when, within its own local logic, a campus wants to initiate a new program.

In budgetary terms, also, there are only three alternative strategies for dealing with growth under severe resource constraint. The first is to find technological and other efficiency breakthroughs to permit more of everything to be done within given resources. Unhappily, this strategy has rarely been found in higher education. The second is to learn to be selective, choosing what is to be done and doing it, if it is done at all, at an efficient scale and a high quality of operation. The third is to spread the budgetary pain, and the resulting academic anemia, more or less uniformly over the whole system.

The most recent procedural development in the central administration is the creation of a successor to the Program Review Board, the Academic Planning and Program Review Board headed by the Vice President of the University and deputy to the President. This body is composed of several university vice presidents, plus four faculty and three student representatives. Its task will be to find ways to winnow out academic program priorities from the large numbers of proposals and plans emanating from the campus administrations.

One major area of possible efficiency gain in a multi-campus university is to identify and exploit possibilities for inter-campus sharing of

resources.

The University's libraries have a combined union catalog and arrangements for inter-campus sharing of books, though this has not appreciably dulled the aspirations of every campus to have major research collections in all areas of library acquisition. There may be possibilities for inter-campus sharing of computer resources, and it is the job of a senior official in the central administration to coordinate University policies and plans for computing.

Academic programs may have some possibilities of inter-campus sharing as well. The Twenty-sixth All-University Faculty Conference, held in March, 1971, had as its topic "The Future of Graduate and Professional Education in the University (of California)." Of a series of resolutions advisory to the President, the sixth one deserves quotation on the issue of inter-campus sharing:

> 6. That the University recognize its unique multi-campus potential in the planning and implementation of graduate and professional programs. Leadership should be encouraged, especially but not exclusively on the developing campuses, to devise innovative and quality programs and degrees. Due attention should be given to state and national needs in the development of these programs. Particular emphasis should be placed upon the use of intercampus facilities through the development of joint degree programs among campuses. To facilitate the implementation of these programs, resources should be made available to enhance communication networks and intercampus transportation of faculty and students.

In the United Kingdom, the University Grants Committee uses as part of its mechanism for determining its allocations to individual universities a series of expert panels in the various academic disciplines. Each of these, composed of distinguished academics in the field, is charged with responsibility to review the strengths and weaknesses of programs at the various universities and determine which of these is in a strong enough position to warrant further expansion. The same All-University Faculty

Conference alluded to this sort of approach in its Resolution 7.:

> 7. That the President consider the appointment of committees for the review of the programs of each discipline or profession; that they be provided appropriate staff support and include outstanding faculty both from the University of California and from other institutions; and that each program review committee should advise the President and the Chancellor of each campus concerning the quality of existing programs and the potential quality of proposed programs, and the status of that field in the University.

These two resolutions are purely advisory. They give voice to a point of view which is appealing in the abstract but competes radically in practice with the incentives on each campus to seek the advancement and expansion of its own programs, with its chancellor as chief advocate and defender. Both geographical and psychological distance separate the campuses. Whether inter-campus sharing of resources and program responsibilities will develop as a significant strategy remains to be seen.

Decisions on program review need substantial analytic support. If a new degree program is under consideration, such questions as the following deserve attention:

(1) Is there evidence of regional and national manpower need in the field for the next decade or more?

(2) What is the potential enrollment demand for the proposed new program, in terms of both quantity and quality of applicants?

(3) Are existing degree programs in the field at other campuses of the University, other public institutions, and private institutions in the region already at or above their minimum size for academic and fiscal viability, or is there available enrollment-taking capacity in these existing programs?

(4) What are the existing resources available on the proposing campus for the new program, what are the available qualitative strengths of the existing faculty, and what budget of incremental resource needs would be required year by year if the new program is adopted? (This question can be divided into

subquestions relating to the rate of build-up of the proposed program.)

(5) What is the "critical mass" or minimum viable size of the program in both academic and fiscal terms, in terms of enrollment, faculty, facilities and other resources, and how soon would this size be reached under alternative trajectories of resource allocation? (Very small programs are often high-cost programs because they require a nucleus of start-up resources.)

(6) What are the advantages and disadvantages of locating the proposed new program at the campus in question, given evidence of the need for it, in terms of community interests and resources, strengths and facilities in related academic departments on the campus, and considerations of compositional balance among programs at the campus in question?

(7) What are the elements of promising innovation in design of the proposed new program, as against existing programs?

These questions are not exhaustive, but they do indicate a range of issues of evidence and analysis.

Where the question of inter-campus or inter-institutional cooperation in courses, faculty or facilities comes forward, additional evidence and analysis are needed. The costs of moving faculty or students between locations need to be estimated. Both the problems and the opportunities of inter-campus cooperation need attention, and the proposal needs to be examined to see whether the problems can be effectively overcome.

A process of explicit program review undeniably raises important issues of social and academic values. It requires a variety of judgments, insights, and modes of analysis if it is to be helpful and effective. Because it requires an effort to examine the implications of a program for the campus, for a multi-campus institution, for higher education more broadly considered, even (in connection with considerations of manpower

needs and career opportunity) for the region and nation, program review may need to be approached in the spirit of systems analysis. There is, of course, the important issue of constraining the domain of matters to be considered so that the cost of examining the problem is not excessive in view of the possible impact which improved analysis can have on the quality of decisions made.

Other kinds of decisions deserve various forms of attention in the spirit of systems analysis. A few of these are mentioned here from the experience of the University of California and will serve as prelude to Part III of this paper.

The first example is drawn from a time when the issues of tuition, or increased student fees, and the related questions of financial aid and improved access to the University, were under active consideration in 1968-69. The College Scholarship Service, a subsidiary of the Educational Testing Service, was hired on a contract to examine the question of financial aid needs and financial aid administration. Concurrently, the University, the Coordinating Council for Higher Education in California, and the State College System cooperated in a major sampling survey of high school students in California. In addition, the University undertook a comprehensive financial survey of students already enrolled.

The analytical staff in the Office of the President developed detailed models showing connections between the participation rates of students from various income and ethnic groups in the California population and the rates of attendance cost and financial aid. Variations of these models were used to simulate the path of facilities expansion which would be needed on various long-term enrollment projections, together with the use of portions of student fees, and other resources for financial

aid and the use of the remainder to finance additional needs for capital outlay for the enrollment expansion. These detailed analyses provided a basis for judging many of the economic and educational consequences of alternative patterns of student fees and of the use of student fees for financial aid and other purposes.

Another example of systems analysis is the examination of the costs and benefits of "year-round operation." The State government had been greatly interested in potential savings in capital construction through more intensive use of academic facilities in the summer interval. The University changed from a semester to an academic quarter calendar in 1966-67, and the State commenced financing of State-supported summer quarters in replacement of fee-supported summer sessions. The first two campuses which initiated summer quarters had lower first-year enrollments than had been hoped for. Both the State Department of Finance and Legislative Analyst and the university administration undertook extensive reanalysis of the issues of year-round operation. There remains substantial controversy about the issue, with the Legislative Analyst and many in the Legislature continuing to support the concept of year-round operation while the Executive Branch desired to avoid the undeniably higher budgeted costs of a State-funded summer quarter, and questions arose in the university administration concerning the educational viability and enrollment potential of summer quarter operations (particularly in the absence of compulsory requirements on students to attend the summer quarter--the issue of compulsion being itself an important philosophical and policy question).

Once again, the analytical work done had to be performed at a high level of sophistication and detail; it contributed to, but was not

necessarily controlling on, the policy decisions that were made.

This discussion serves as prelude to Part III of this paper, where we will discuss a number of new tools and approaches to policy analysis for higher education systems and institutions.

FOOTNOTES

[1]"Planning and Analysis in the University of California," OECD Conference in Paris, France, April 1969, conference volume forthcoming.

[2]"Scientific Manpower Trends for 1970-1985, and their Implications for Higher Education," Chicago, Illinois, December 27, 1970. See also, F. E. Balderston and Roy Radner, "Academic Demand for New Ph.D.'s, 1970-90: Its Sensitivity to Alternative Policies," Ford Foundation Program for Research in University Administration, Paper P-26, Berkeley, California, December 1971.

PART III

PERSPECTIVES AND APPLICATIONS OF POLICY ANALYSIS

INTRODUCTION

Three years ago Allen Schick (1969) concluded that "PPBS is an idea whose time has not quite come ... (and that) PPBS must make do in a world it did not create and has not yet mastered." This observation is particularly true of PPBS in higher education. In its use to date in the state and federal governments in the United States, planners have emphasized the mechanics and the formalism of PPBS far more than the concepts and spirit of PPBS. However, if PPBS is to be relevant to higher education, its proponents must emphasize the concepts and spirit far more than the formalism.

The paradigm of the Department of Defense is particularly inappropriate for planning and management in higher education for several reasons.[1] Educational institutions foster diversity, seek differentiated instead of homogeneous viewpoints, operate on a collegial system in which each faculty member considers himself *primus inter pares*, decentralize management to dozens of department chairmen and deans, and rarely attempt to determine institution-wide operational objectives. In higher education the informal collegial structure is often more important than the formal structure of rotating department chairmen and transient presidents [Glenny (1971)]. Without clearly defined objectives and without sharp lines of authority and responsibility, the formal structure of PPBS serves little use beyond giving outside observers a false sense of precision and security. While basic analysis is often very useful for educational decision making, as we will illustrate later, the organizational and political environment of most institutions of higher education effectively preclude the full implementation of PPBS.

Wildavsky (1969) concludes his critique of the meager implementation of the activity oriented PPBS in federal agencies:

> All the obstacles previously mentioned, such as lack of talent, theory, and data, may be summed up in a single statement: *no one knows how to do program budgeting* [author's emphasis].

Furthermore, the criticisms of Wildavsky, Schick and Merewitz and of Soznick (1971) are far more global than simply deploring the lack of technical knowhow. The purely formal, "systems budgeting" approach followed by many who have attempted to implement PPBS ignores the entire institutional and political context of academic decision making.

An academic administrator reaches a decision partly on the basis of his world view, his underlying philosophy about his role in the organization and the role and nature of his institution in the larger society. He also brings to bear his beliefs about cause and effect, of functional causality in his institution, and of the differential effectiveness of the various possible decisions. These beliefs are based on the received doctrine and folk wisdom of academia passed down from mentor to protegé and on the ideosyncratic experiences of each individual in his own education. In addition, each decision maker applies his own priorities and values in the choice of a few among many good outcomes.

The institutional and political contexts of decision making have a major impact on all of these factors. Individuals are employed and promoted partly on the basis of their conformity to institutional norms. Deans or department chairmen who view their role significantly differently from their academic colleagues soon find themselves isolated and ineffective. Young faculty who prize teaching over research (or vice versa) do so at the peril of their career in an institution which rewards opposite values. Executive officers who assume they are acting within a formal

hierarchical structure soon find that academic collegiality and strict organizational accountability are incompatible.

The dominant expectations and basic assumptions prevalent in an institution circumscribe the feasible or acceptable decisions available to an administrator. Effective leaders recognize these implicit assumptions, values and priorities and incorporate them in their process of decision making.

In addition, virtually all educational institutions must deal with larger clienteles: alumni, the surrounding community, statewide administrative systems, state governments, and the federal government. There is a corresponding political context of these relationships which also reflects one or more sets of basic assumptions, values and priorities which might conflict with the respective assumptions, values and priorities of the institution or of any administrator within the institution. This external political context also circumscribes the scope of acceptable decisions for the institution.

Much of the frustration and perceived impotence of academic administrators results from these multiple, overlapping and at times inconsistent systems of internal and external strictures. To economists or quantitative analysts these bureaucratic and political considerations often seem irrational, unnecessary, and certainly untidy. On the contrary, if formal tools and techniques are to be of assistance to educational administrators, these tools and techniques must recognize and incorporate the institutional and political reality of planning and management in higher education.

However, even if institutions were completely receptive and willing to embrace PPBS as a comprehensive, formal planning and management system, most institutions do not have the technical and analytic underpinnings to

support a PPB System. In many institutions student data resides in handwritten records filed in the registrar's office, financial accounts are kept on clipboards hanging on the wall, faculty assignments and workload, if recorded at all, are on scraps of paper in a departmental secretary's desk, space records are on 3 x 5 cards and a card sorter and check printer constitute the administrative data processing installation. By contrast, some schools are developing extensive machine-readable files and sophisticated administrative data processing capability which are essential for an economically feasible PPB System and which are the foundation for the analytic planning tools and techniques that are being developed [Weathersby (1972a)].

Alternatively, educational managers can either begin by focusing on the activities of the institutions, or the objectives, or begin by turning to the major decisions facing the president or the board of trustees. As we have discussed in Part I, the earliest efforts at PPBS in higher education were based on activities. For example, the College and University Business Administration Manuals [Van Dyke et.al. (1968)] recommend as budget categories: instruction and departmental research, organized activities, sponsored research, extension and public service, libraries, student services, maintenance and operation of plant, general administration, staff benefits, general institutional expenses, student aid, and auxiliary enterprises. The Program Classification Structure developed by the National Center for Higher Education Management Systems collapsed these activities into seven categories: instruction, sponsored research, community service, academic support, student support, institutional support, and outside enterprises [Gulko (1971)]. Some subsequent developments have focused on objectives, however poorly defined, including new knowledge created, knowledge transmission, skill attainment, and community well-being [University

of California (1970)]. While both of these are very useful conceptualizations, the dimensionality of their full implementation has so far exceeded the capabilities of any institution and a comprehensive analysis of either institutional activities or objectives is a very major task [Dressel et.al. (1971)].

Policy analysis is an alternative approach which uses decisions as the major organizing principle instead of activities. In higher education these decisions might be student admissions, tuition, faculty staffing, library acquisitions, new construction, or new academic program development, among others. The approach of policy analysis is to bring careful analysis to bear incrementally in specific decision problems and build up a planning and management "system" on a case law or precedent basis.

A policy analyst begins with the necessity for decision, identifies the variables relevant to the decision, seeks the relationships between the variables he can control and the remaining relevant variables, examines the values associated with the outputs or consequences of the decision, evaluates alternative strategies characterized by different specifications of the control variables (including new technologies and alternative organizational patterns), and designs decision, implementation and evaluation processes which legitimize and actualize the decisions of an administrator.

Good policy analysis is specific, incisive, and insightful, sympathetic to the concerns of the operating level while cognizant of the institutional and political context of decision making, focused on key decisions yet cumulative and integrative over time, responsive to short term crises yet preparatory for longer term analyses probing the basic causality of the institution. Good policy analysis is also often traumatic and discomforting,

producing counterintuitive (but hopefully correct) results, laying bare basic assumptions and values, exposing ignorance and uninformed judgment, making choices very explicit and operative preferences known to all in the decision process. There is nothing mysterious about policy analysis. In Wildavsky's words, "The whole point of policy analysis is to show that what had been done intuitively in the past may be done better through sustained application of intelligence."

In the next sections we discuss the necessary analytical base for effective policy analysis, the various foci and characteristics of policy analysis, and an example of policy analysis applied to the decision of adopting year-round operations for an institution.

ANALYTICAL BASE FOR POLICY ANALYSIS

Policy analysis for higher educational planning and management requires, in addition to setting goals and establishing effective decision processes, the development of an analytical base consisting of (a) institution-specific information, (b) operational theories of causality with as much general empirical evidence as possible, and (c) a repertoire of analytical tools and techniques which support the planning function. In the past few years there have been extensive developments in all of these areas and, although most institutions are not able to support a full-scale PPB System, the state of the art is sufficiently advanced, in our judgments, that many institutions can conduct rigorous analyses of important policy decisions and can develop the requisite analytical base for ongoing decision-specific analyses.

Institutional Information Systems

Management information systems have generated considerable interest and received major financial support in the years following the publishing of the Henle Report in 1965. In the past five years a number of institutions have developed computer data systems tailored for their own administrative needs and patterned after their own organizational structure. In many cases, these developments merely automate traditional financial and business services, but in part they represent a fundamental rethinking of information flows and decisions. Ohio State University, Stanford University, University of Pittsburgh, University of Toronto, University of California and various other institutions are well down the road toward improved, decision-oriented management information systems [Fielden (1969)]. As we discussed previously, this area is of prime concern to the National

Center for Higher Education Management Systems (NCHEMS) at WICHE and they are developing "standard" definitions and procedures for collecting, aggregating and reporting information [Minter and Lawrence (1969)].

With the exception of NCHEMS, most of these developments in information systems have been institution-specific and not easily transportable or applicable to different institutions and for these reasons are not discussed in greater length here. The specific NCHEMS projects and documentation for planning and information systems were discussed in Part I.

General Explanatory Research[2]

Although much of the research in higher education has been of the purely descriptive type, there has been a significant number of attempts to explore the causal relationships operative in higher education. These more broadly construed and more generally useful theories and conceptual models have rigorous bases in cognitive, behavioral or economic theory and provide some supporting empirical justification. A very brief, selected and non-comprehensive description follows.

The student sector of higher education has received the major attention of these explanatory efforts. Astin of the American Council on Education has been very actively engaged in research on student achievement and the impact of the institution on student characteristics [Astin (1964, 1968a, 1968b, 1969)]. Chickering (1969) has also explored the effects of institutional differences on student achievement. Perl (1969, 1971) has analyzed the Project TALENT data to determine the effects of educational technology and resource application patterns on student academic achievement and B.A. completion rates. Morris (1972) has investigated the differential effects of early academic specialization versus a more general educational experience on subsequent employment patterns.

On the economic side, Hoenack (1968) estimated the effects of additional student fees on student enrollment. This study accounted for differences due to parental income, commuting distance from the institution, and fees charged at competing educational institutions. Subsequently, Miller and Radner (1970) and Miller (1971) estimated the joint effects on student enrollment of institutional fees and tuition and verbal ability, on an individual basis and average for the institution. Such demand studies enable educational planners to estimate the effects on future enrollments of anticipated tuition increases (or decreases). Furthermore, these demand studies coupled with the supply and replacement demand estimates of Folger (1970), Balderston and Radner (1971), Cartter (1971), and Adkins (1972), and cognizance of the structural issues in manpower supply and demand raised by Weathersby (1972b), enable planners to examine the balance between supply and demand and, possibly, to determine appropriate directions of improvement.

Also using economic theory, Breneman (1971a, 1971b, 1971c) described doctoral degree completion in terms of departmental prestige maximization which is partially tied to the placement of recent graduates. Breneman's study complements Freeman's (1971) extensive labor market examination and his largely market driven explanation for observed differences in doctoral completion rates. While Breneman takes a prestige maximization view of departmental decision making, at least as it applies to doctoral degree programs, Hobbs and Anderson (1971) take an organization theory point of view of departmental operations. Along with Dressel et.al. (1971), Hill and French (1967), Marcson (1962), and Walker and Holmes (1960), Hobbs and Anderson point out that departments are complex amalgams of collegia and oligarchies largely without any central objective function.

The general problems of the financing of higher education have been thoroughly discussed by Bowen (1969), Balderston (1971), Bowen and Douglass (1971), Cheit (1971), and Jellema (1972). Many of the central issues in institutional governance, finance, organization and operation have been extensively investigated and reported by the Carnegie Commission on Higher Education and the Center for Research and Development in Higher Education. While few institutions will find this general research completely relevant to all of their decisions, institutional planners should be cognizant of this general research and use it to the fullest extent possible in their decisions. Particularly now in higher education's continuing fiscal depression its leaders cannot afford to reinvent the wheel for every new crisis.

Planning Tools and Techniques[3]

As we mentioned in Part I, a significant repertoire of useful analytical planning tools and techniques has been developed over the past seven years. The basic purpose of these analytical models is to project the future given the current state and the planned future decisions. These models are typically quantitative simulators that respond to "what if" questions: What will the student enrollment be if we send acceptances of admission to 1,000 new students? What will the tenure ratio be if we promote 40% of our assistant professors? What will it cost if we add a new program in environmental engineering?

Descriptive models are either *comprehensive*, including some representation of student and faculty flows, curriculum, staff, space, administration, support costs, etc., or *specialized* in one or more of these areas or in other areas. Comprehensive models began in 1965 at the University of

Toronto [Judy and Levine (1965)] and the University of California [Weathersby (1967)] and now include CAMPUS V, VI, and VII [Judy, et.al. (1970), Levine and Mowbray (1971)] available from the Systems Research Group in Toronto; Resource Requirements Prediction Model (RRPM) [Gulko and Hussain (1971), Hussain (1971), and Hussain and Martin (1971)] available from the National Center for Higher Education Management Systems at WICHE; SEARCH/CAP:SC [Keane and Daniel (1970)] available from Peat, Marwick and Mitchell; and at a lower degree of comprehensiveness and sophistication, HELP/PLANTRAN [McKelvey (1970)] available from the Midwest Research Institute. All of these models have been pilot tested with real institutional data and all of the developers can certify that the computer programs actually work. As shown in Weathersby and Weinstein (1970), CAMPUS, RRPM and SEARCH all have approximately the same scope and compass with CAMPUS being somewhat more detailed.

There are other comprehensive models which have been developed as research efforts but have not been extensively tested in institutional settings and which have no associated organizational maintenance and support of the computer software systems. Prominent among these models are the Michigan State University State Space Model [Koenig et.al. (1968)], the Tulane Model [Firmin et.al. (1967)], the RAND-Air Force Model [Allison (1970)], and the Washington Model [Thompson (1970)]. The University of California Cost Simulation Model [Weathersby (1967)] was tested at Berkeley and UCLA before its metamorphosis into RRPM.

At the current time, a number of institutions are developing their own comprehensive costing models and, undoubtedly, the next few years will see a major increase in institution-specific models for planning and management in higher education.

SPECIALIZED MODELS

A large number of specialized analytical planning models have been developed in the last decade, and these can be discussed most conveniently in terms of their areas of application.

Enrollment Forecasting and Student Flows

Many of the specialized models focus on student enrollment because of its importance to educational planning and resource acquisition.[4] These student flow models range from the course level enrollment patterns used by Caspar (1969), Dietze (1969) and Turksen (1970) to the interinstitutional enrollment forecasting and control embodied in the State of Washington's Higher Education Enrollment Projection (HEEP) Model [Washington (1970)]. In between are the institutional models developed by Young and Almond (1961), Gani (1963), Oliver (1968), Perl and Katzman (1968), Oliver and Marshall (1969), Marshall, Oliver, and Suslow (1970), Newton (1970), Smith (1970), and Sandell (1971).

Most of these models are mathematically very simple; usually linear estimating equations with no recognition of uncertainty, curriculum, or financial aid. Most of these student flow models distinguish only the level of the student and not his major field of study or socioeconomic characteristics. One significant exception from these generalizations is Turksen's work which does explicitly recognize uncertainty, student preferences and curriculum at the individual student and course level of detail. Several comprehensive models also contain student flow subroutines, including CAMPUS and the MSU State space model.

Two independently developed but closely related national enrollment forecasting models are those developed by Pfefferman (1970) and Jewett (1971).

Pfefferman's model, later extended by Mathematica (1971), forecasts national enrollments by level of student, type and control of institution and income distribution of students' families. Jewett's model forecasts the national able-to-pay population of high school graduates with a joint distribution of financial aid needed and verbal SAT score. Neither of these national models relates directly to an individual institution or system but they do shed some light on the aggregate student population.

Many of the "explanatory" models have focused on student characteristics as discussed in a previous section. In addition, some of the prescriptive or optimizing studies include student admission decisions, which will also be discussed in a subsequent section.

Faculty Staffing and Activities

The effects of tenure on a faculty have been investigated by Bartholomew (1969), Oliver (1969), and O'Toole (1972), in terms of new appointments, promotions and attrition. The decision problem of "optimal" faculty hiring to attain and maintain a desired tenure/nontenure mix was formulated and solved by Rowe, Wagner and Weathersby (1970). CAMPUS has a faculty flow module very similar to a student flow model which could add realism for programs with falling faculty demands.

In addition to the comprehensive models described above, there are several specialized models which compute the required or desired faculty size based on student instructional needs. The Krings-Finkenstaedt (1969) formula used at the University of the Saar and the more disaggregated Braun, Haumer and Schmid (1969) model calculate needed faculty by field from student enrollment, average teaching loads and the desired student/faculty ratio. The Oliver, Hopkins and Armacost (1970) model, and the

later Oliver and Hopkins (1971) model calculate institutional faculty requirements from manpower demands on the basis of a network flow model which is operationally very similar to the national faculty requirements linear input/output model developed by Nordell (1967). In a different vein, Halpern (1970) developed an institution-fundor gaming formulation for total faculty positions and calculated the region of strategic acceptability.

A final area that has received considerable analytic attention although not in formal models is that of faculty activity analysis. For many years institutions have queried their faculty on their distribution of effort or their contribution to various institutional outputs, e.g., knowledge transferred, new knowledge created, etc.[5] A meaningful faculty activity analysis gives new insight into the allocation and productivity of education's most valuable resource--its faculty.

Physical Facilities

Although capital costs are often a very small percentage of the total cost of higher education, the near-irreversibility and high visibility of capital decisions has made them the subject of a great deal of analysis and recently some analytical modeling. For a comprehensive statement of the current state of the art in facilities planning and analysis, see Dahnke et.al. (1971).

In addition, Smith (1970) has developed a course scheduling algorithm which allocates classes to classrooms by size according to student demand for courses. The Facilities Analysis Model (FAM) developed for the California Coordinating Council for Higher Education [Mathematica (1970)] simulates the effects of different time schedules for facilities in terms of the operating and capital costs as well as the facilities utilization.

FAM is a very detailed model with detail by clock hour, room size and type and class size, type, and discipline. Furthermore, FAM was redesigned by the University of California and the new model, called Space Planning and Cost Estimating (SPACE) includes several Monte Carlo probabilistic randomizations [Smith and Wagner (1972)].

In another vein, Sanderson (1969) developed a multi-campus expansion model formulated as a network and solved as a mathematical programming problem. This model could be useful to systems or states facing the choice of building a new campus or expanding existing campuses. Winslow (1971) analyzed the capital costs of a campus by discipline and described an "optimal" space allocation procedure. Wing (1971, 1972) has analyzed the capital costs of medical education.

Course Enrollment

Perhaps the single most useful instrument for analyzing student course enrollment and induced faculty workload patterns is the induced course load matrix (ICLM) originated by Donovan Smith of the University of California. Basically, an ICLM describes what courses students of a particular level and major have taken (or are expected to take) in each level of each department (or discipline). An ICLM or its equivalent is a key component of CAMPUS and RRPM as it links student enrollment with faculty teaching load. The variability of the ICLM over time has been investigated by Jewett et.al. (1970) in an excellent study at California State College at Humboldt. Also, the pilot test experience with the ICLM is described in the RRPM documentation [Hussain and Martin (1971)].

Other Specialized Descriptive Models

Morse (1968), Williams et.al. (1968), Leimkuhler and Cooper (1970) and Palmour and Wiederkehr (1970) have done extensive research in modeling

library operations, including acquisition, circulation, demand, remote storage and associated costs. Ruefli's (1970) Generalized University Simulation is composed (at least conceptually) of numerous specialized models for various administrative functions. However, to date none of these models have been reported to be operational. Wilson et.al. (1969) report on the use of a special version of CAMPUS designed for the health sciences. Croy (1970) and Bruno and Marcus (1971) present input/output techniques for the analysis and attribution of indirect costs in higher education.

PRESCRIPTIVE OR OPTIMIZATION MODELS

Predicting future consequences of current decisions can be of great assistance to an administrator because it gives him more information on which to base his decision. Similarly, explicating the cause and effect relationships can not only add to an administrator's understanding of his institution but also ensure that the future consequences of current decisions are predicted in the best possible way. However, even with all of this additional information, the administrator's task of integrating the factual observations and future estimates with his judgmental values and goals is still very difficult. The primary purpose of optimization models is to assist in this complex association of goals with decisions.

There have been at least two approaches to departmental management using optimization techniques. Fox and Sengupta (1970) have developed a linear output pricing model for departmental operations and applied a linear programming technique to determine an optimal mix of departmental activities. Geoffrion et.al. (1971) followed a different approach of recognizing that deans and department chairmen have nonlinear multi-attributed criterion functions that are unarticulated and very difficult

to assess globally. However, with the help of some simple arithmetic manipulations and graphics, departmental managers can assess local tradeoffs and that is all the preference information needed at each iteration to solve a general nonlinear optimization problem.

Institutional management has also been formulated as an optimization model. Wagner and Weathersby (1971) follow the approach of having administrators identify targets, such as a student/faculty ratio or tenure/nontenure ratio, or a campus size of 2,500 undergraduates, instead of assessing general utility functions. They show that for very general cases one can calculate a set of decisions which will best achieve the planning targets for the institution.

Furthermore, several of the specialized models discussed previously have optimization components. Rowe, Wagner and Weathersby applied optimal control theory to faculty staffing. Halpern calculated optimal bounds for new faculty positions. Sanderson used nonlinear programming to determine optimal capital expansion paths. Wilson et.al. used linear programming to allocate professional staff among medical services in the health science version of CAMPUS.

Although an optimization model must include a descriptive component, those optimization models that have been actually developed and tested are much smaller than the large scale simulators. Consequently, the computer costs of solving these optimization models have been very small in many cases. This makes it financially feasible for administrators to explore several possible targets or tradeoffs and examine the implications of different value systems as well as different decisions.

In summary, the conceptual, analytical and empirical developments of the past few years provide an extensive base for individual institutions

and agencies to build upon in their analysis of policies. In the next section we describe some of the salient characteristics of policy analysis before presenting a brief case study of actual applications.

FOCI AND NATURE OF POLICY ANALYSIS

At least in North America, decision making in higher education is diffuse. Many individuals are involved at the national, regional, state or provincial, local, institutional system, and campus levels; and undoubtedly these individuals perceive the issues and possibilities of planning differently. Consequently, there is no simple description of the appropriate foci for policy analysis in the broad spectrum of higher educational planning.

Recently Ben Lawrence (1971) enumerated some of the issues requiring the attention of the higher education community in the coming years as student access and accommodation, changing functions of postsecondary education, certification, accountability, institutional finance, student aid, and institutional resource allocation. Major decision issues confronting higher education have also been discussed by Berdahl (1971), Glenny et.al. (1971), and Meyerson (1971) among others. It is critical that each agency or institution focus on the issues which are individually relevant; this relevance is difficult to define operationally and to generalize across institutions.

However, we can identify the salient characteristics of policy analysis which apply to the various subjects of attention. Wildavsky (1969) describes policy analysis as follows:

> Policy analysis is expensive in terms of time, talent, and money. It requires a high degree of creativity in order to imagine new policies and to test them out without requiring actual experience. Policy analysis calls for the creation of systems in which elements are linked to one another and to operational indicators so that costs and effectiveness of alternatives may be systematically compared. There is no way of knowing in advance whether the analysis will prove intellectually satisfying and politically feasible. Policy analysis is facilitated when: (a) goals are easily specified, (b) a large margin or error is allowable, and (c) the cost of the contemplated policy makes large expenditures on analysis worthwhile.

Furthermore, we observe that policy analysis structures information. All institutions collect some data to satisfy their fiducial responsibilities; most institutions somehow count students, faculty and dollars. These data and their structure are not value-free. On the contrary, the very choice of which variables to include in the institutional data base reveals a great deal about the values, assumptions, objectives and major decisions of the institution (or agency). Does an institution monitor how many tenured faculty are women, how many new student admissions are Black, how many new administrators are analytic, how many suppliers are equal opportunity employers, how many courses are redundant, duplicative, poorly attended, or anachronistic, how many tenured faculty are no longer active in their field, or how many members of the community are engaged in institutional activities? Its data base is both a description of an institution and the vocabulary of decision making for an institution; therefore, to be truly useful a data base should describe what is important to the institution.

Policy analysis focuses on decision variables. Most institutional data are aggregates, e.g., the total numbers of faculty, students or square feet, while most decisions are made at the margin, e.g., new faculty hired, new students admitted, or new space constructed. Basically, policy analysis focuses on the costs and benefits of alternative decisions and, consequently, needs data relevant to decisions not to aggregates. This decision focus also structures information in new and very useful ways [see Wagner and Weathersby (1971)].

The impact of policy analysis is often that it questions the appropriate locus of organizational decision making. If the president has as much (or more) data than department chairmen, there is often a great temptation for the president to make the decisions formerly made by the

department chairmen. Similarly, if the state or provincial coordinating board has as much (or more) information than the institutional president, there may be strong pressures (labelled public accountability) for making institutional decisions at the statewide or provincial level.

The fundamental point is that policy oriented data bases and planning tools make more information available to more people and this information can be used to restructure institutional decision making. While this is not an inevitable conclusion, it is very probable that additional organizational stresses will be generated by the existence of such policy relevant data. This raises the whole question of the criteria for the evaluation of decision making and the operational impact of accountability.

Policy analysis anticipates key decisions. Good analysis takes time while major decisions are often made in great and justifiable haste. Acknowledging and overcoming this dichotomy is one of the keys to effective policy analysis. In this regard, good policy analysts must look 6 or 12 or over 24 months in advance, attempt to identify the latent crises and then lay the necessary analytical groundwork. After trying to do this for a number of years we have two empirical observations: (1) to be successful in policy analysis one must dare to be wrong, and undoubtedly will be some of the time (which requires a secure administrator) and (2) old problems never die and rarely fade away but follow a cyclical reincarnation in new guises because they are rooted in fundamental value conflicts. Therefore, if your guess was wrong this year, save the analysis because the issue will probably recur next year.

Finally, there are many times when no analysis helps. Educational planning and management is still a great deal more art than science, divisive issues are more often symbolic than analytic. Rigorous analysis

can show that two campuses would both be better off economically to share computer or library resources but such advice will be refused with disdain if both campuses view their library or their computer as a symbol of their academic stature and vitality. A manager responsible for educational planning must view his resources for policy analysis as scarce and avoid unproductive investments and truly unbeatable foes. In many cases, careful analysis of alternative policies can be of help to administrators as we show in the following example.

A CASE STUDY OF YEAR-ROUND OPERATIONS

In educational systems experiencing significant growth in enrollment, it has often been suggested that capital costs can be reduced by using the existing physical facilities more intensively and at somewhat higher operating costs. As long as the additional operating costs of extended operations are less than the otherwise additional capital costs, there will be a cost savings associated with a change from the traditional 9-month academic year to year-round operations (YRO). The quest for these savings has led many institutions, including Florida, Pittsburgh and the University of California, to implement some form of YRO. Unfortunately, the savings have been largely illusory, and Florida, Pittsburgh, and the University of California (UC) have all abandoned YRO. In this section we briefly describe the UC experience with YRO and the role of policy analyses in the decisions to implement and to abandon YRO.

Background

Anticipating California's burgeoning enrollments in the 1960's, McConnell et.al. (1955) suggested the possibility of YRO in 1955 in their Restudy of the Needs of California Higher Education. In 1957 the Academic Plan for the Berkeley Campus included the expansion and incorporation of summer sessions into the regular instructional program. Two years later the Berkeley Academic Senate Committee on Educational Policy recommended a 2-1/2 semester calendar to help "meet the student load of the future without acceleration and other disadvantages of the World War II program." [Suslow and Riley (1968)].

The 1960 Master Plan for Higher Education in California directed the newly formed Coordinating Council for Higher Education to "study during 1960 the relative merits of trimester and four-quarter plans for year-round use of the physical plants of both public and private institutions, and on the basis of that study recommend a calendar for higher education in California" [Post (1970)]. However, in 1962 before the Coordinating Council actually began their study, the University of California decided to adopt a four-quarter YRO pattern that would be "planned and timed to preserve, and if possible to increase, academic quality."

While the UC decision was primarily made on educational grounds influenced by severe physical and fiscal constraints, the focus of YRO discussion shifted almost entirely to its fiscal characteristics. In 1964 the Coordinating Council issued their report endorsing YRO in general and the quarter system in particular on the basis of their analysis that the 1967 to 1975 increased operating costs for UC and the California State Colleges of $109.7 million would be more than offset by the anticipated capital savings of $177.2 million. In other words, the Coordinating Council anticipated a net savings of $67.5 million to result from adopting YRO even when conversion costs were included. In 1968 the Coordinating Council contracted with a private consulting firm to reevaluate the fiscal implications of YRO and it concluded that UC and the State Colleges would save a net amount of $85 and $12 million respectively through 1975-76 [Touche Ross (1968)].

This consistent pattern supporting the "obvious" cost savings of YRO was completely reversed in 1970 in the "Report on Higher Education, Year-Round Operations" prepared by the California Department of Finance, Budget Division, in which they concluded

> The net result of continuing Quarter System/Year-Round Operations at the State Colleges and the University will be to *increase*

> substantially the total tax supported costs per FTE student enrolled in higher education without appreciably increasing the utilization of the facilities or FTE production on a yearly basis. [Department of Finance (1970), emphasis added]

Meanwhile, the University had come almost full circle. In 1966, to save money and maintain academic equality, UC adopted a 3-quarter system for all campuses except Berkeley which immediately began 4-quarter YRO. One year later UCLA began a 4-quarter YRO program. In 1970, summer quarters at UCLA and Berkeley were cancelled for "lack of funds" and the UC System is currently on a 3-quarter calendar with campuses having separate, self-supporting summer sessions. The reasons for this complete reversal within two years (1968-1970) both by state agencies and by the University are interesting and instructive of the positive and negative impacts of analysis on policy formulation.

Analysis of YRO

Over the past decade the costs and benefits of YRO have been analyzed many different ways and, as we have seen, have resulted in contradictory recommendations. While each study has been organized differently, the central elements in all studies have been: (1) capital costs and utilization; (2) accommodating student demand; (3) increased operating costs of YRO including academic management of course offerings, class size, etc. In most of these cases simplistic analysis has been very misleading and focused, detailed analysis has shed a different light on the issues.

Physical Facilities

One of the driving forces for YRO is allegedly inadequate physical capacity. Clearly, if an institution has adequate physical facilities its capital needs will be small and the increased operating expense of a

fourth quarter cannot be justified. However, the precise meaning of "adequate capacity" is not so clear. For example, if unit space allotments are reduced, as some legislators have done, the "capacity" of the existing plant will be increased in theory if not in practice. Table 1 shows the capacity and enrollment figures for the University of California for 1970-1980. There is not the prospect of a great deal of construction and, therefore, the potential savings from foregone construction are low.

When changing the space use standards the full capital and operating cost impacts are rarely considered. However, when institutions schedule their classrooms for use late in the day or on weekends, the average class size typically declines and the total operating costs for a fixed number of students consequently increases under constant faculty workload. The purpose of the Facilities Analysis Model, which was described previously, is to enable planners to determine the least total cost pattern of facilities use recognizing both capital and operating costs over a reasonable planning horizon. The University has found that its SPACE model approximates quite well the actual space utilization and staffing experience of the campuses investigated. Recently, Smith and Wagner (1972) have used SPACE to explore the capital-operating-utilization tradeoffs operative in the University and some of their results are shown in Table 2.

In the last few years the State of California has dealt with capital outlay requests for higher education in several ways: (1) refused funding because of ongoing state fiscal crises (most frequent response); (2) increased mandatory space utilization rates which increase apparent capacity of current facilities and reduces justification for additional facilities (which happened in 1971); (3) encouraged UC to find capital funds elsewhere from the federal government, private sources and student fees (which

TABLE 1

Comparison of Enrollments and "Capacity" of
University of California General Campuses for 1970-1979

	Enrollments	Capacity[a]
1970-71[b]	98,239	97,637[c]
1971-72[b]	97,301	105,575
1972-73	100,749	105,400
1973-74	104,096	107,476
1974-75	108,700	113,190
1975-76	112,500	116,206
1976-77	115,100	118,944
1977-78	117,700	123,869
1978-79	120,400	128,040

[a]1972-77 Capital Improvement Program as of August 27, 1971, subject to revision.

[b]Actual three-term average head count.

[c]All capacity numbers are three-term average head count and assume current discipline mix.

TABLE 2

Summary of Classroom Utilization Rates, Assignable Square Feet, and Variable Costs 10-Year Runs, 1969-70 - 1978-79, Using UCSB Data

Performance Measurement	Starting with Actual Fall 1969 Inventory			
	Lumpy Schedule*		Flat Schedule*	
	67-Hr. Week (Run 10A)	44-Hr. Week (Run 12B)	67-Hr. Week (Run 11A)	44-Hr. Week (Run 12A)
(1)	(2)	(3)	(4)	(5)
Classroom Utilization (average in the 10 years)				
WRH per Room	30.5	30.3	32.9	31.3
Station Occupancy	0.50**	0.48**	.52**	0.47**
WSH per Station	15.4	14.5	16.9	14.8
ASF per WSH	0.87	0.91	0.82	0.90
Assignable Sq. Ft. in the 10th Year (in thousands)				
Classrooms	127	136	119	133
Class Labs	229	225	212	221
All Other I&R	535	537	544	539
Total I&R Facilities	891	898	875	893
Total Variable Costs in the 10 Years (in millions)				
Salaries & Support	$ 145.3	$ 147.4	$ 152.2	$ 148.6
M&O of Plant	17.6	17.7	17.4	17.7
Debt Service***	16.8	17.1	15.9	17.1
Total Variable Costs	$ 179.7	$ 182.2	$ 185.5	$ 183.3

*"Lumpy" = varying numbers of classes in different hours, as in actual schedules.
"Flat" = as nearly equal numbers of classes in all hours as is possible.

**0.60 to 0.75 in most room-size ranges, but the overall ratio is reduced by the disproportionate effect of a few very large rooms.

***For bonds by which construction is assumed to be financed.

the University is now doing); and (4) funded capital outlay from the State general funds (a very infrequent occurrence). Not only have these decisions largely ignored the educational and induced operating cost implications, they have also removed the prime justification for YRO--there can be no capital outlay savings when the state is not supporting capital outlay at all.

Student Enrollment

As long as the total enrollment of an institution is growing or the disciplinary mix of students is changing substantially, there is at least the possibility of YRO savings. In 1960 the University of California anticipated an average annual growth rate of approximately 10%. By 1970 the anticipated rate of growth had fallen to 4%. With increased fees, economic recession and changing social values the University's actual annual rate of growth in student enrollment was less than 1% in 1971-72. This has reduced the compelling pressures for expansion and for the adoption of YRO.

However, the analysis for YRO included more than simple enrollment projections. A very resourceful study by Donovan Smith (1969) showed that while the addition of a fourth term theoretically increased the enrollment "capacity" of a campus by 33%, any reasonable assumptions about student schedules, vacations, and terms of continuous attendance reduce the capacity gain to the range of 7-9%. Furthermore, the student and course scheduling problems increase enormously and these reduce the probabilities of satisfying student demands and their timely graduation. These considerations reduce the benefits and therefore reduce the attractiveness of YRO.

An even greater difficulty with the early YRO analyses was the assumption that summers were previously unproductive when in fact substantial

numbers of regularly matriculated students continued their studies in self-supporting summer sessions. The two campuses on four-quarter YRO, Berkeley and Los Angeles, realized a summer quarter enrollment which was approximately 32% of their average three-term enrollment in 1969-70 and when the fourth quarter was eliminated the enrollment in summer sessions was approximately 15% of the same three-term enrollment [Walsh (1971)]. In other words, the net gain in enrollment in the summer quarter was roughly one-half of the summer quarter enrollment. However, the operating costs in the summer quarter were funded by the State at the same rate as in any other quarter (approximately $1,600 per FTE student per year). As a consequence, the *operating cost per additional student accommodated in the summer quarter was roughly twice the cost per additional student in each of the other three quarters.* What started out to save money in fact cost over $3,000 per additional student per year.

The California Department of Finance recognized this in their analysis when they concluded [Department of Finance (1970)]:

> The semester/summer session system FTE student output was substantially underestimated. This resulted from ignoring or discounting the educational output of the summer session.
>
> The decision to convert to Quarter System/Year-Round Operation included an implied decision for the State to assume support costs in lieu of the self-supporting summer sessions. If this were done system-wide in 1969-70 at a support cost of $1,600 per FTE student, it would cost $29.6 million annually. Although the subsequent annual costs would grow with future enrollment, the $29.6 million one time additional costs would fund the capital costs of additional facilities for 3,500 students for 30 to 40 years.

Analysis of Operating Costs[6]

The University of California's decision to adopt YRO was largely a judgmental one based on consideration of academic quality, faculty workload, expanding student enrollments and changing student preferences.

Although no quantitative analysis of the cost consequences of a four-quarter system was made, the unfortunate financial experience of some universities that have plunged into year-round operation (particularly the University of Pittsburgh) indicates at least the possibility of severe economic consequences.

However, the operating costs of YRO are amenable to simulation analysis. The major uncertainty lies in the cost consequences of the summer or fourth quarter, and one technique used by UC in the analysis of summer quarter operation was to vary one or more parameters of the summer quarter and observe the effect on the total system's cost. Three models of annual operation were formulated and the results compared to the annual cost of enrolling the same total number of students in a continuation of the semester operation with all other parameters unchanged. This is the most meaningful comparison because the decision is actually between two alternative modes of operation. Other readily available measures such as cost per student, student/faculty ratios, etc., all ignore the total systems cost aspect of the analysis.

An analysis was done for the Berkeley campus both because there existed adequate data and because Berkeley was scheduled to have the first summer quarter operation in the University, beginning in 1966. Three models were investigated using Berkeley as an indicator of system-wide behavior. These models are described below.

Model 1 - Linear Growth

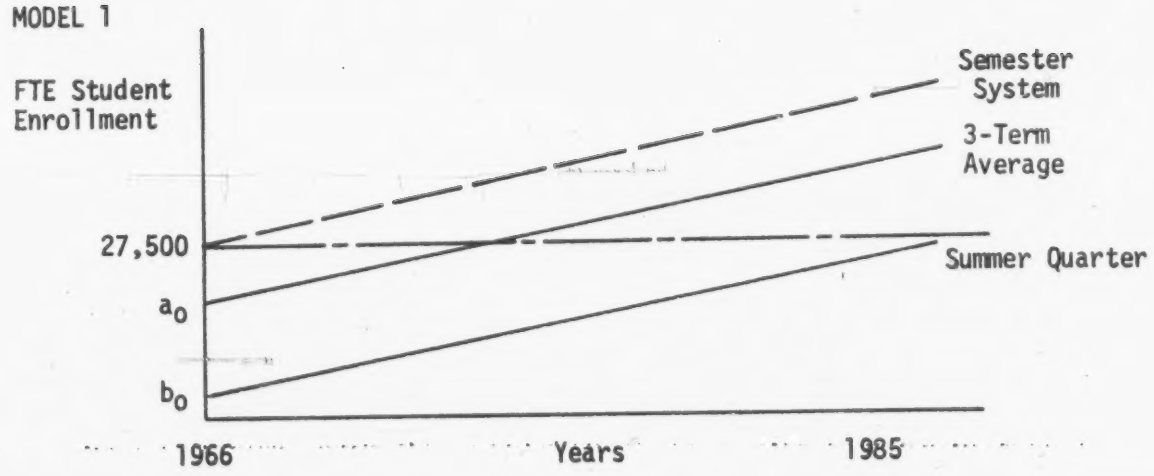
Model 1 described a constant increment in the total annual student enrollment. Under the semester system, these students would be accommodated by building new facilities, increasing the staff, etc., to maintain

the existing instructional pattern. This part of the analytical formulation was a direct application of the University of California Cost Simulation Model [Weathersby (1967)]. Under the quarter system, the total number of students divided between the summer quarter and the regular three-term instructional program. The ratio of summer quarter FTE enrollment to the three-term average (y), was varied from 20% to 100%. For each value of a sequence of summer enrollment percentages (y), the class size in the summer quarter was reduced until the present value of the twenty-year total systems cost, capital and operating, of the four-quarter system just equalled that of the semester system.

The class size was chosen as the critical parameter because the experience at other universities has indicated that while adopting the quarter system saves capital expenditures, the increased operating costs of the summer quarter often offset or even exceeded the saved capital costs. The high summer quarter operating costs arise from the decision to maintain a full course offering in the face of a lower student summer enrollment. To some extent the decrease in enrollment can be absorbed by decreasing the number of sections and thus maintaining the same average class size. However, once all of the multiple sections are reduced, there is no alternative other than a decline in mean class size if a full course offering is to be maintained. Therefore, we wanted to know what decline in the mean class size would equalize the discounted costs of the semester and quarter systems. The policy implication of this analysis was that if the university regulates its course offerings such that the subsequent decline in mean class size is less than or equal to the critical value we calculated, then the quarter system would possess an economic advantage over the semester system, all other attributes being equal.

FIGURE 1

Entire System Enrollment Pattern



Model 1 increases total student enrollment at a constant rate beginning at 27,500 FTE. The semester system (dotted line) immediately exceeds the current enrollment while under the quarter system (solid lines) the three-term enrollment immediately falls to a_o and grows steadily while summer quarter enrollment begins at b_o and grows at the same rate. The ratio of b_o to a_o is defined as y and describes the percent the summer quarter is of three-term enrollment.

The twenty-year total cost streams consist of two major components: the annual operating costs and the annual capital outlay costs which are appropriately spread over the years preceding the expected occupancy date in the actual cash flow pattern. Because the simulation model was formulated in constant dollars, general operating costs were inflated at 3% a year, faculty salaries at 5% a year, and capital costs at 4% a year to recognize the relevant price trends. Then the twenty-year total systems cost was reduced to present value at a 5% cost of capital. The results of Model 1 are given in Table 3 below and graphically in Figure 1. Several general observations regarding Model 1 were made. Notice from Figure 1 that initially the three-term average enrollment drops below the current semester enrollment with the degree of decline depending upon the y ratio. With $y = 100\%$, it is 10 years before any cash flow capital costs are required anticipating that the three-term average will exceed the initial physical capacity approximately 15 years past the initial point. As the y value declines, the lead time to future capital outlay expenditures shrinks to zero at $y = 40\%$. Also, it is startling that the decline in class size necessary to drive the two cost streams equal (Table 1) is such a flat function of y. Essentially this means that there is a fairly even tradeoff between capital costs and operating costs. Implicit in this formulation is the assumption of constant returns to scale (i.e., no economies of scale) during the fourth quarter. This aspect of the problem is investigated in detail in Models 2 and 3.

No further analysis of Model 1 was performed because it was felt to be unrealistic. The most artificial assumption was that the three-term average FTE enrollment would decline below the current level and gradually climb back up and exceed the present level. This assumption was modified in Models 2 and 3 which are described below.

TABLE 3

Critical Class Size Values for Cost Equality Between
Semester System and Quarter System Operating Under Model 1

Ratios of $\frac{\text{4th Quarter FTE Enrollment}}{\text{3 Term Aver. FTE Enrollment}}$ (y)	Percent Decline in Class Size
1.00	13%
0.80	13
0.60	13
0.40	12
0.20	10

TABLE 4

Table of f Factors Describing Economies of Scale
For Summer Quarter Support Operations

Functional Form	Numerical Value
Constant	1.0 0.8 0.6 0.4 0.2
Linear	$f = y$ $y = (0.2, 0.4, 0.6, 0.8, 1.0)$
Log-Parabolic	$f = 15.4\, y^2$ $\quad y \leq .18$ $f = .328 + .672 \log(10y)$ $\quad y \leq .18$

Models 2 and 3 - Increasing Returns to Scale

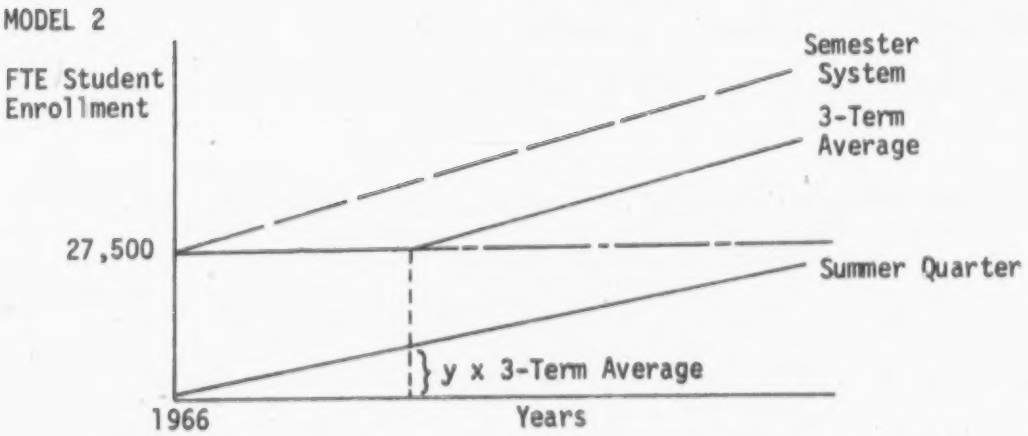
Models 2 and 3 will be discussed together because of their basic similarities and common assumptions. Model 2 postulated a dynamic growth over time in the total enrollment of a campus or of the system. The explanation pattern assumed is shown in Figure 2. According to Model 2, the additional enrollment is shunted into the summer quarter until the ratio of the annual FTE student enrollment of the summer quarter to the three-term average equals the predetermined value y. At that point, both the three-term average and the summer quarter expand in proportion. As before, the expansion of the three-term average necessitates additional capital outlay. As before, the present value discounted stream of operating and capital costs were compared with continued semester operation accommodating the same total annual enrollment and the summer quarter class size was varied to equate the two present valued cost streams.

Model 3 postulated a one-time enrollment increase occurring at the beginning of the period and maintained through all future periods. It was the officially endorsed plan of action for the University of California for operations from 1966-1970. The enrollment pattern is shown in Figure 3. Once again the summer quarter enrollments considered were various fractions of the three-term average and the comparative semester system's total enrollment varied with the y value chosen to reflect the same total annual enrollment.

A major refinement of Models 2 and 3 over Model 1 was that operating economies of scale were postulated for the summer quarter. In addition to the obvious capital savings associated with student instructional facilities, one would logically expect that many administrative and service agencies would not have to expand proportionately to the increased summer enrollment.

FIGURE 2

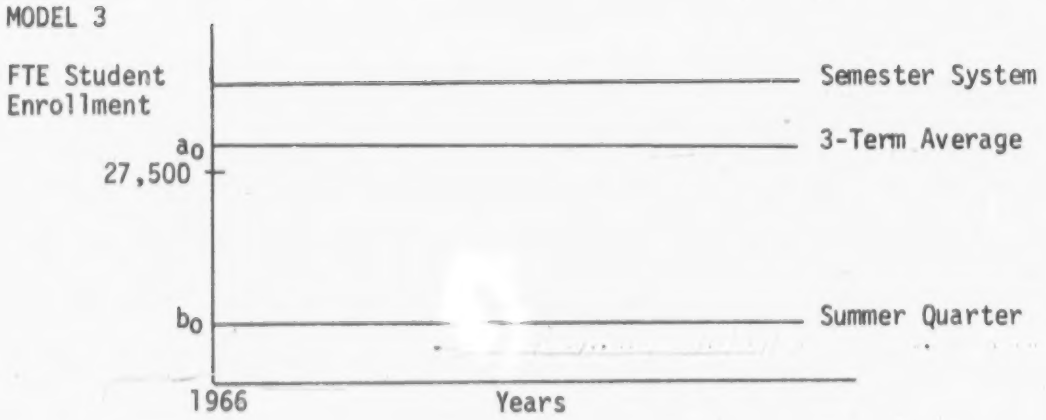
Growing Campuses Enrollment Pattern



Model 2 also increases total student enrollment at a constant rate beginning at 27,500 FTE. The semester system (dotted line) is the same as in Model 1. However, unlike Model 1, Model 2 accommodates all the growth in total FTE enrollment in the summer quarter until the summer quarter enrollment is y % of the three-term enrollment from which time they both grow at the same rate.

FIGURE 3

Mature Campuses Enrollment Pattern



Model 3 describes a one-time change in total enrollment which is then constant into the future. The same total enrollment is accommodated in both the semester and the quarter systems with the ratio $b_o/a_o = y$.

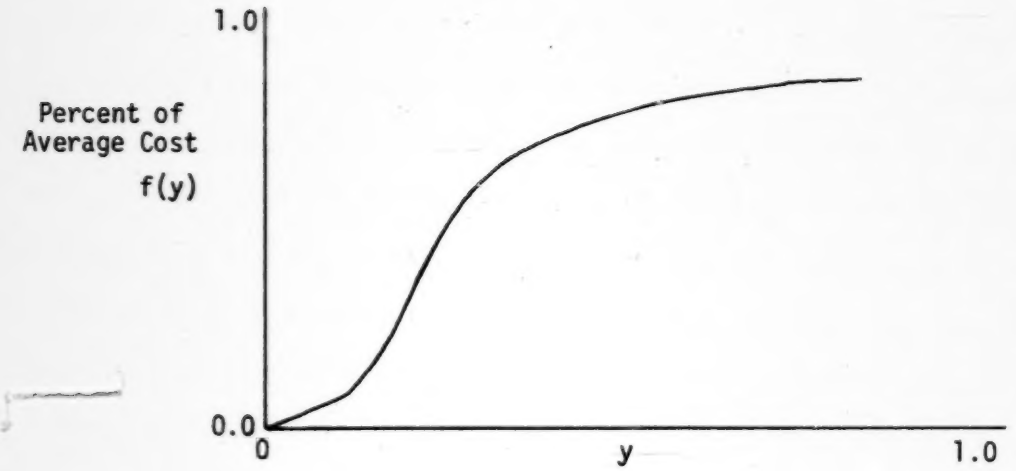
To some extent, the summer quarter operation could take advantage of the excess capacity or under-utilization during the summer of the libraries, the college and department offices, the registrar's office, and other support services. An important cost that is often ignored in the planning of summer quarter operation is the additional cost of faculty appointed for 9 months or 11 months but who customarily receive office and research space for a full 12 months. Since more faculty will be needed for year-round operations, more total research and office space needs to be constructed or provided, thus incurring additional capital costs that tend to offset some of the anticipated savings of operating costs.

To quantify precisely these anticipated economies of scale is a difficult task requiring much more research than currently available. In the absence of the results of such research, several possible forms of the economies of scale functions, denoted f, were hypothesized and investigated. The functional forms and values chosen for this efficiency factor are given in Table 4. A graph of this last function is shown in Figure 4. The actual numerical values were chosen to normalize $f(y)$ such that $f(0) = 0$ and $f(1) = 1$. This last S-curve expression describes a system in which the major economies of scale occur for small y values and fail at an increasing rate for larger y values. In other words, a summer quarter enrollment that was 10% to 20% of the three-term average could be accommodated within the existing capabilities with little additional costs. However, once this slack is absorbed, a higher student enrollment in the summer quarter would require an expansion of current capabilities and thus abrogate some and eventually almost all of the economies of scale of summer quarter operation.

These factors were introduced into the formulation of both Models 2

FIGURE 4

Plot of S-Curve Function Showing Economies of Scale in Summer Quarter Support Operations



The mathematical expression in Table 4 describes the S-shaped curve shown above. For proportionately small summer enrollments, low values of y, the cost of summer quarter support operations would be proportionately small, low values of f. When summer quarter enrollments are as great as three-term average enrollments, the average support costs in the summer would be the same as in the regular terms.

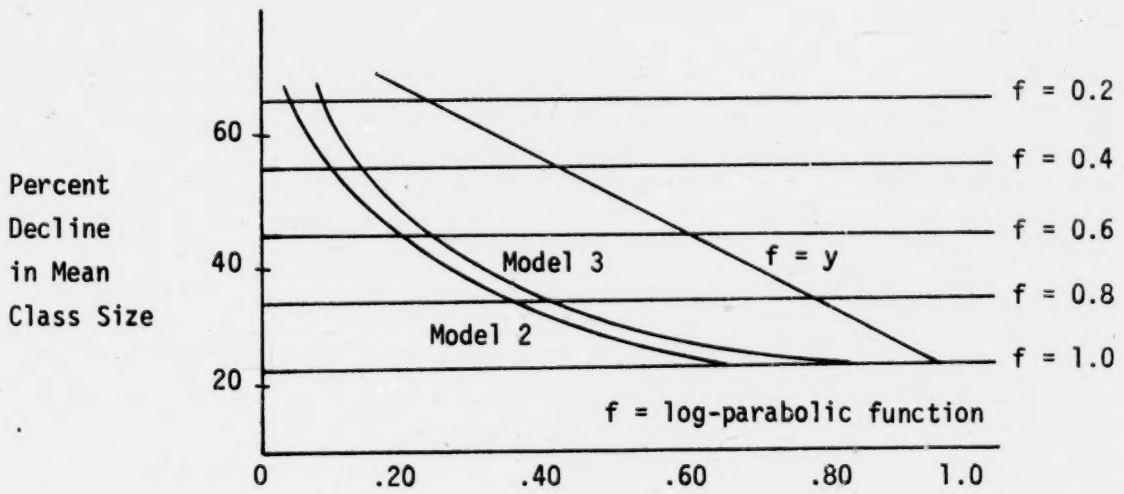
and 3 and the decrement in mean class size in the summer quarter necessary to drive equal the present value of the operating and capital cost streams of both the semester and the quarter systems were derived by Newton's convergence method and by use of the simulation model. The results are given in Figure 5.

Several important observations can be derived from these results. Notice that in all cases the calculated break-even percent decline in mean class size was greater than 20%. This meant that an academic administrator could permit a relatively large course offering in the summer quarter. With different sectioning policies operative on different campuses, it is nearly impossible to translate these class size observations directly into the number of courses to be offered. However, as a result of this analysis the academic administrator did have a decision rule available that: "The direct economic advantage of the quarter system operation will probably be maintained if the decision maker considers the additional constraint that the campus-wide decline in mean class size for any proposed summer course offering is less than or equal to 20%." If additional research should indicate that the S-curve function is a reasonable representation of economies of scale, then the 20% constraint could be relaxed somewhat depending upon the value of y.

In summary, to the extent that these various analytic models accurately describe the behavior of the University system, we are now in a position to say something about the relative direct economic feasibility of different calendars or modes of operation. Model 2 describes an expanding campus or system while Model 3 portrays the "mature" campus. In both of these cases the results given in Figure 5 indicate the feasible regions for combinations of y values and efficiency functions. Thus an academic administrator can relate capital costs, operating costs, economies of course

FIGURE 5

Critical Class Size Region for Cost Equality Between Semester System and Quarter System Operating Under Models 2 and 3



The region below the f-function curves shown above describe the relative economic advantage of the four-quarter YRO system. In the region above the f-function curves the two-semester system would possess the relative economic advantage.

offerings, summer quarter enrollment, and economies of scale in administrative agencies in a single plane. Used sagaciously, this analysis both could prevent major economic blunders by at least bounding the feasible region and could simultaneously indicate the fruitful avenues of future research or of profitable administrative control.

Epilogue

Where did all of this analysis lead? In 1970 the University abandoned YRO because it cost too much. Conceptually, YRO appears cost-effective, on the average YRO is analytically cost-effective, as we have seen above, but at the margin *for the University of California* YRO was not cost-effective. Because of UC's high summer session productivity, because of the State's decision not to appropriate requested capital outlay funds, and because of the slackening growth in enrollments, the University decided that there were no real cost savings in YRO. In fact, YRO for the University required major cost increases for which no funds were available.

CONCLUSION

By mid-1971 the U.S. federal government had almost come full circle on PPBS. George Schultz (1971), Director of the Office of Management and Budget, announced that for budget proposals for fiscal 1973:

> Agencies are no longer required to submit with their budget submissions the multi-year program and financing plans, program memoranda and special analytical studies as formally specified in Bulletin No. 68-9.

In other words, the formalism of PPBS will no longer be *required* by OMB, although they may request supporting documentation in PPBS format. In interpreting this action, Merewitz and Sosnick (1971) state "OMB had discarded program accounting, detailed description of activities, and zero-base budgeting, and it has restricted multi-year costing and benefit-cost analysis to expenditures that would represent *new policy decision*" [emphasis added].

This action by Schultz is entirely consistent with our views of decision analysis and gives credence to the observation that the benefits from the formalism of PPBS may not be worth the costs induced by the enormous machinery of PPBS, especially where the agency involved is subject to a wide variety of internal pressures and external conflicts. On the other hand, specific analyses of focused policy decisions can be of great assistance to administrators in government and in higher education. In this paper we have proposed the essential characteristics of such decision-focused analyses, the necessary analytic base, and we have illustrated the impacts of analysis in an actual case history. There are no easy, automatic answers to the problems of higher education nor is analysis an easy, automatic process. Careful planning requires the judgment to know the difference between good analysis and bad and the courage to support an unpopular decision made for the right reasons.

FOOTNOTES

[1]See Wildavsky (1969) for a discussion of the inappropriateness of the Defense Department as a model for other federal agencies.

[2]This section and the next are a revised form of the text first presented at the National Forum for Higher Education Planning and Management in January, 1972 [Weathersby (1972a)]. It is included here both for completeness of presentation and because of the limited circulation and availability of the earlier text.

[3]For a thorough review of the literature on descriptive models, see Weathersby and Weinstein (1970), Weathersby (1972a) and Schroeder (1972). The first reference gives comparative tables assessing model complexities and capabilities.

[4]For a thorough review of the literature of student flow models, see Lovell (1971).

[5]For an example, see University of California (1970), and for an extensive bibliography, see Romney (1971).

[6]This section is adapted from a chapter in an unpublished report by Weathersby (1967).

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